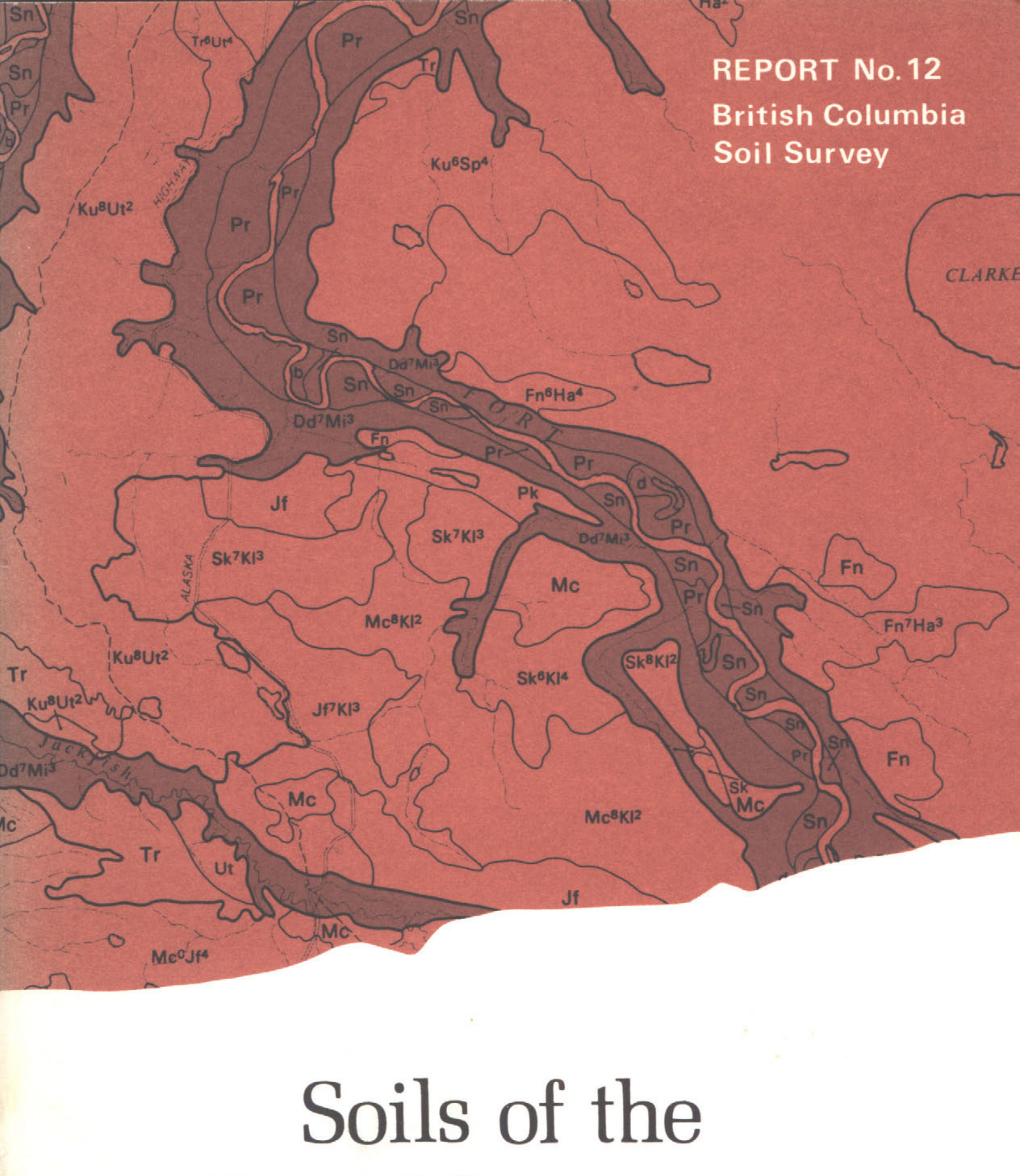
REPORT No. 12
British Columbia
Soil Survey



Soils of the Fort Nelson Area of British Columbia

RESEARCH BRANCH · CANADA DEPARTMENT OF AGRICULTURE

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Canada Department of Agriculture, Vancouver, B.C.

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CONTENTS

Tables

Figures

Alphabetical Index of Soils and Land Types

PREFACE

The soils of the Fort Nelson area (94J NE), in the plains region of northeastern British Columbia (Fig. 1), were surveyed during July and August 1967. A preliminary report of the soils along the Alaska Highway and the major navigable rivers had been made by Leahey (5). The whole area lies within the Fort Nelson Lowland (4), which is a gently undulating plain dissected by three major rivers, the Muskwa, Prophet, and Fort Nelson. Access is afforded by the Alaska Highway, the roads to the Clarke Lake natural gas fields, and a number of short side roads. Most of the area, however, is inaccessible to a normal wheeled vehicle in summer because of the extensive sections of organic terrain and the steep-sided river valleys. A helicopter was used for 4 days to map this portion. The soils of the alluvial terraces from Fort Nelson downstream to the Indian Village of Snake River were inspected by boat. Fig. 2 shows the portion mapped from the roads and the river and also that mapped, in much less detail, by helicopter traverse and air photo interpretation.

The first part of the report describes the environment, including climate, vegetation, and physiography. The second part describes the soils and the land types in the context of physiographic regions called terrain systems. The third part includes interpretative sections for agriculture, forestry, wildlife, and recreation.

The colors and symbols on the soil map show the distribution of the individual soils. The report and map are complementary and both should be used to gain information about the soils.

GENERAL DESCRIPTION OF THE AREA

Location, Settlement, and Land Use

This report deals with approximately 1,200 sq miles around Fort Nelson in northeastern British Columbia. The 1:50,000 National Topographic Survey areas covered are 94J 9, 10, 15, and 16.

The principal settlements in the area are Fort Nelson, Old Fort Nelson, and Muskwa. Old Fort Nelson was established on the east bank of the Fort Nelson River in the late 19th century after a previous settlement on the west bank had been destroyed by a flood. The present Fort Nelson townsite was established during the Second World War when the Alaska Highway was built and the airport was used as an RCAF base. It lies on the plateau above the river at the junction of the airport road and the Alaska Highway. Until 1958, when natural gas was discovered on the plateau to the east, the population was only 600; it was made up principally of army personnel and highway maintenance crews. Since then, drilling operations for natural gas, the expansion of the forest industry, and the service industries for tourism have increased the population of the whole area to approximately 2,500.

A gas scrubbing plant has been constructed to the south of Fort Nelson and a sulfur plant is planned. Six sawmills in the area produce planed construction lumber. White spruce is the principal commercial wood. Total production in 1967 was approximately 12 million board feet.

There is no commercial agriculture in the area. Carefully tended vegetables in local gardens show good growth on the alluvial terraces of the Fort Nelson River. A series of trial plots were conducted on the plateau at Mile 319 of the Alaska Highway in 1964, 1965, and 1966 by personnel of the Canada Department of Agriculture from the Research Station, Beaverlodge, Alta. (3). The trials showed that parts of the area have a potential for the production of a wide variety of cereal, oilseed, and forage crops.

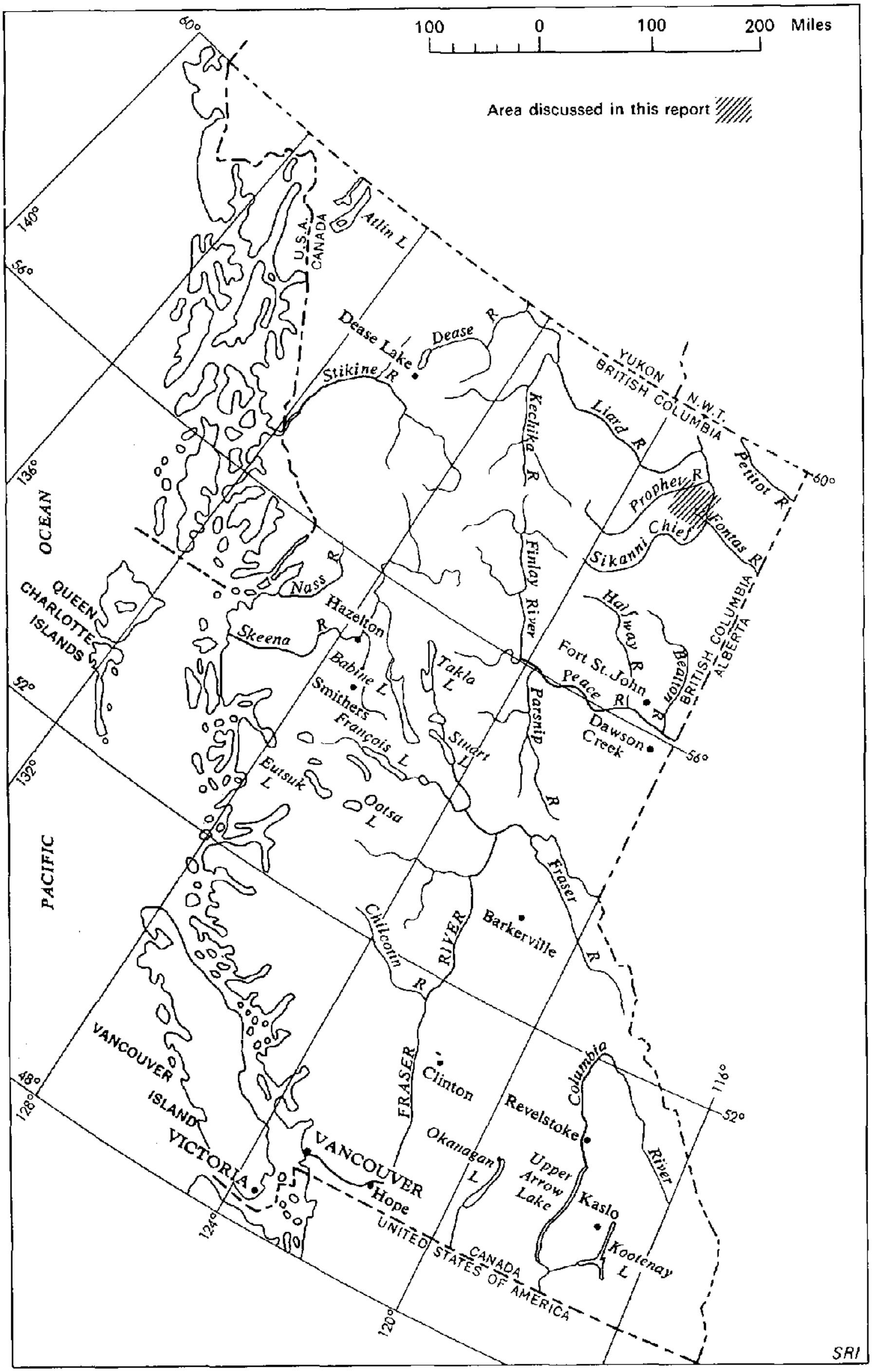


Fig. 1. Outline map of British Columbia, showing the location of the Fort Nelson area.

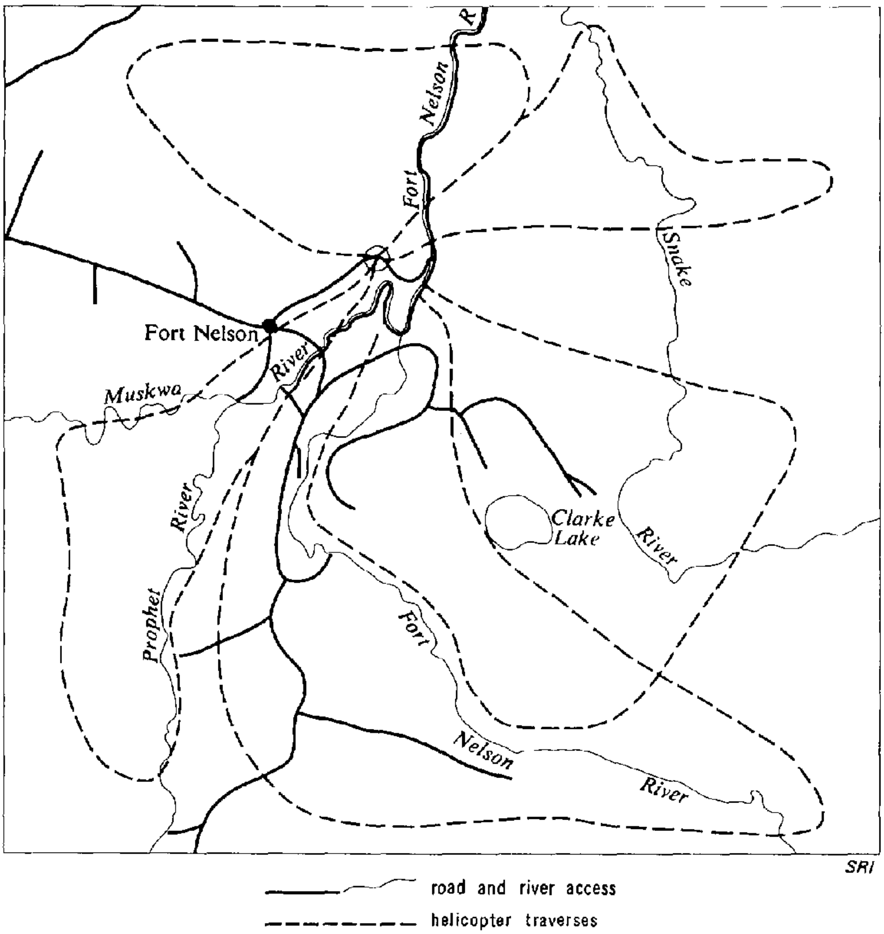


Fig. 2. Road and river access and helicopter traverses within the surveyed area.

The future of the natural gas, sulfur, lumber, and agricultural enterprises of the area depends on accessibility to markets. Thus, the extension of the Pacific Great Eastern Railway from Fort St. John to Fort Nelson is of the utmost importance to the future of these industries.

Climate

The Fort Nelson area has a boreal climate, characterized by short cool summers, severe winters, a wide annual range of temperature, and a modest total annual precipitation, most of which falls in the summer.

The climate is dominated by continental polar air masses that center over the Northwest Territories. Cyclonic storms from the Pacific intrude only rarely in winter. Their occurrence is more frequent in summer, but they are weak after crossing the Coast and Rocky mountains.

The only permanent meteorological station in the area is at Fort Nelson airport. Meteorological data for this station are given in Table 1. Only 4 months have a mean daily temperature of 50 F or over, although the shortness of the summer is partly offset by the 18 hr of daylight in the midsummer days. The frost-free season at the 50% probability level is 102 days at 32 F and 134 days for killing frosts of 28 F. The number of growing degree-days is just over 2,000. The short nights limit total ground radiation, giving a relatively small range of daily temperatures. Winters are long and cold. December, January, and February have mean daily temperatures of or below 0 F. The diurnal temperature range is low.

Total precipitation is only 17.1 inches due to low temperatures, low relative humidity, and the restriction of cyclonic intrusions by the strong anticyclonic air masses. However, 60% of the total precipitation occurs mainly as rain in the 5-month growing season from May to September.

Estimates for temperature and related agroclimatic elements calculated with the Hopkins regression formulas (12) show that the frost-free season, growing season, and total growing degree-days decrease significantly with increasing altitude (Table 2). The 1,000-ft level approximates the valley bottoms, the 1,500-ft level is slightly higher than Fort Nelson airport, and the 2,000-ft level is a little lower than the summit heights of the plateau in the west. However, the valley bottoms are liable to advection frosts all year due to topography, and actually have a shorter frost-free season than Fort Nelson airport on the plateau.

An important result of the long cold winters is the permanent freezing of the ground surface in some sections. The permafrost map of Canada (2) shows the whole of the area to be within the southern fringe of the permafrost region. Permafrost layers occur consistently just below the surface in the deep organic terrain and in sections of mineral soils where dense vegetation cover or restricted drainage does not allow the soil to thaw completely in the summer.

Table 1. Meteorological Data for Fort Nelson Airport; Elevation 1,230 ft above Sea Level

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year	Source
Mean daily temp., F	-8	0	16	35	50	58	62	59	49	34	10	-5	30	1
Mean rainfall, inches	0.00	0.01	0.02	0.23	1.39	2.60	2.56	1.99	1.17	0.37	0.02	T	10.36	1
Mean snowfall	9.5	10.3	10.0	5.1	1.5	T	0.0	T	1.7	6.4	12.1	11.1	67.7	1
Total precipitation	0.95	1.04	1.02	0.74	1.54	2.60	2.56	1.99	1.34	1.01	1.23	1.11	17.13	1

Date of last spring frost, 50% probability level: 28 F, May 9; 32 F, May 25	2
Date of first fall frost, 50% probability level: 32 F, Sept. 4; 28 F, Sept. 20	2
Minimum period between last spring and first fall frosts, 50% level: 28 F, 134 days; 32 F, 102 days	2
Growing season (42 F): average first date, April 30; average last date, Sept. 30	3
length of growing season, 153 days; number of degree-days, 2,085	3
Potential evapotranspiration, 19.5 inches; moisture surplus, 1.1 inches; moisture deficit, 3.6 inches	3

Sources:

1. Temperature and precipitation tables for British Columbia, Can. Dep. Transport, Met. Br., Toronto, 1967.
2. Calculations by ARDA. Agroclimatology Sector, B.C.D.A., Victoria (6).
3. Unpublished data for ARDA. Agroclimatology maps, A. L. Farley, Dep. Geography, Univ. British Columbia, Vancouver, B.C.

Table 2. Estimates of Normals of Temperature and Related Agroclimatic Information for Various Elevations in the Fort Nelson Area

Elevation	Mean daily temp., F												
	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
1,000 ft	-5	2	15	35	51	60	63	59	49	36	13	-2	31
1,500 ft	-3	3	16	34	48	57	60	56	48	35	15	1	31
2,000 ft	-1	5	16	32	46	54	56	53	46	34	16	3	30
2,500 ft	0	6	16	30	44	51	53	51	44	33	18	4	29

	Frost-free season, 32 F	Killing frost-free season, 28 F
1,000 ft	100 days	124 days
1,500 ft	80 days	109 days
2,000 ft	50 days	92 days
2,500 ft	17 days	79 days

	Growing season, 42 F			Number of degree-days
	First date	Last date	Length	
1,000 ft	Apr. 27	Oct. 6	162 days	2,430
1,500 ft	May 1	Oct. 1	153 days	2,039
2,000 ft	May 5	Sept. 27	145 days	1,612
2,500 ft	May 10	Sept. 22	135 days	1,301

Source: Estimates derived from the Hopkins regression formulas (Williams and Sharp, 1967) by the Agrometeorology Section, Plant Research Institute, Res. Br., Can. Dep. Agr., Ottawa.

Physiography

The Fort Nelson area is a level or gently undulating plateau underlain by marine shales of the Buckinghorse formation and sandstones of the Sikanni formation within the Fort St. John Group of Lower Cretaceous age (11). The three main rivers, the Fort Nelson, Prophet, and Muskwa, have entrenched their beds 300 to 400 ft into this plateau to form narrow, steep-sided valleys. During the last major glaciation the Wisconsin Laurentide continental ice sheet moved west and southwest across the plateau from a center just west of Hudson Bay. This ice sheet just reached the area, its outer limit being to the immediate west. The Wisconsin Cordilleran ice did not extend this far east. The ice was probably not very thick and its erosive power was limited. Drift deposits are therefore thin, or, on the higher ground, entirely absent; and most soil parent materials are directly related to the underlying bedrock. The exceptions are the soils that have developed on the sands deposited over the plateau during deglaciation and the alluvial soils of the valley bottomlands.

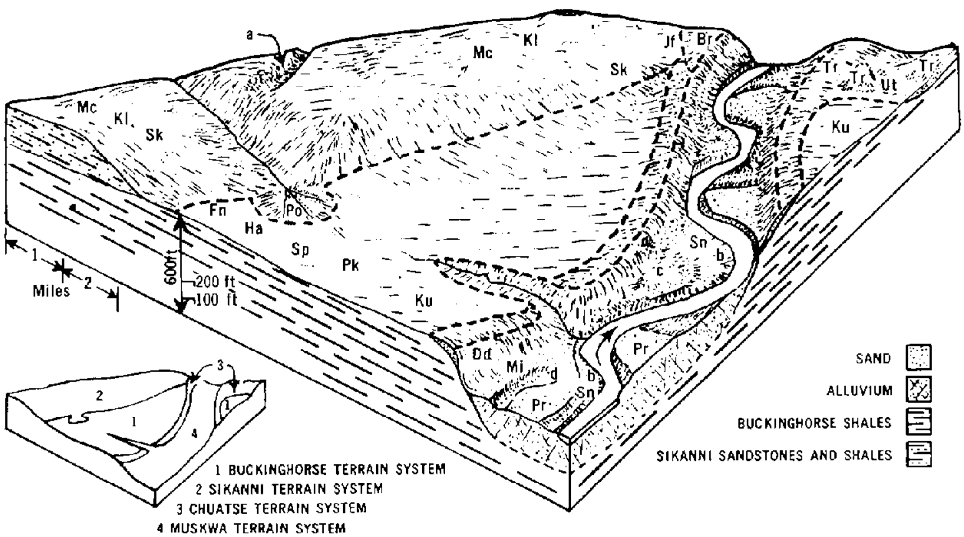
With the retreat of the ice sheet a thin capping of sand was laid down over much of the center of the area, and along the river valleys. The subsequent formation of the deep river valleys has left these sand deposits as narrow strips along the plateau edge bordering the valleys.

The glacial map of Canada (9) shows a proglacial lake extending into the southeastern corner of the area. Traces of deltas farther west imply that the lake extended farther into the area and that the sands may be of lacustrine rather than glaciofluvial origin. Similarly it was difficult to separate clays of possible lacustrine origin from thin glacial drift deposits derived, with little disturbance, from the soft marine shales of the Buckinghorse formation. The scale of mapping, the lack of previous work, and the inaccessibility of much of the area precluded any detailed study of the geomorphology before soil mapping began. Therefore, the soils have been mapped within four terrain systems rather than grouped according to the genesis of their parent materials. A terrain system is defined as an area of land having a recurring pattern of surface materials, morphology, and geology. Its observable properties rather than its inferred genesis are used to define it. It can be mapped at a scale of 1:250,000.

Thus, the four terrain systems described below are based on the distinct materials and surface expression of the Buckinghorse formation, the Sikanni formation, the sandy plateau, and the steep-sided river valleys. Fig. 3 is an idealized block diagram illustrating their main features, and Fig. 4 shows their distribution within the area.

The Buckinghorse Terrain System

The Buckinghorse terrain system is the largest of the four terrain systems. It is a gently inclined plain that extends from east to west across the center of the area. In the west the elevation is approximately 1,250 ft above sea level, and in the east just over 1,500 ft. Most of this plain is underlain by the silty marine shales of the Buckinghorse formation, but in the far east these shales are capped by the Sikanni sandstones and Sully marine shales. The slight inclination of the plain is caused by these formations, which overlie the Buckinghorse and gradually wedge out to the

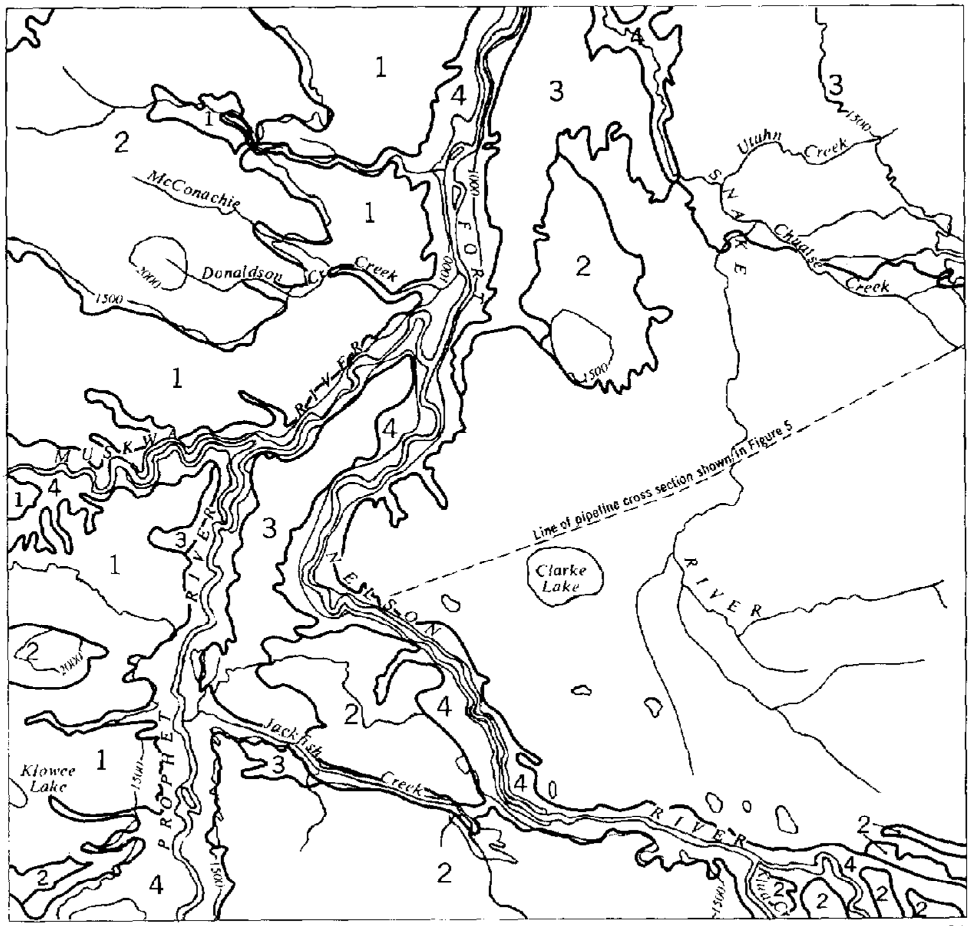


SOIL SERIES AND LAND TYPES OF THE FORT NELSON TERRAIN SYSTEMS

BUCKINGHORSE	SIKANNI	CHUATSE	MUSKWA
Fn FORT NELSON series	a MELTWATER CHANNELS land type	Br BAR series	b RECENT BARS land type
Ha HAMILTON series	Jf JACKFISH series	Tr TRAIL series	c VALLEYSIDE SLUMPS land type
Ku KLUA soil complex	Kl KLOWEE series	Ut UTAHN series	d ABANDONED RIVER CHANNELS land type
Pk PARKER series	Mc McCONACHIE series		Dd DONALDSON series
Sp SIMPSON series	Po POUCE series		Mi MILO series
	Sk SIKANNI series		Pr PROPHET series
			Sn SNAKE series

SRI

Fig. 3. The terrain systems of the Fort Nelson area.



Terrain Systems: 1 Buckinghorse 2 Sikanni 3 Chuatse 4 Muskwa

Fig. 4. Map of the terrain systems of the Fort Nelson area.

west. The unconsolidated mineral material is a dark silty clay containing very few coarse fragments. Most of the plain has a slope of less than 2% and surface water runoff is very limited. Therefore the predominant surface material is organic, mainly sphagnum peat more than 24 inches thick. A 25-mile section along a pipeline of the Westcoast Transmission Co. Ltd. showed that the only places where mineral soil came to within 24 inches of the surface were near the rivers where the slight slope of the narrow valleys afforded better drainage (Fig. 4 and 5). Numerous lakes and meandering streams, which in the east often occupy meltwater channels, afford the only relief to the monotonous regularity of this organic terrain. It is within this organic terrain that most of the sections of permafrost occur.

Where the Buckinghorse terrain system borders the irregular outliers of the Sikanni sandstone, which forms the plateau of the Sikanni terrain system, slopes of up to 5% afford moderately well drained conditions producing mineral rather than organic surface materials.

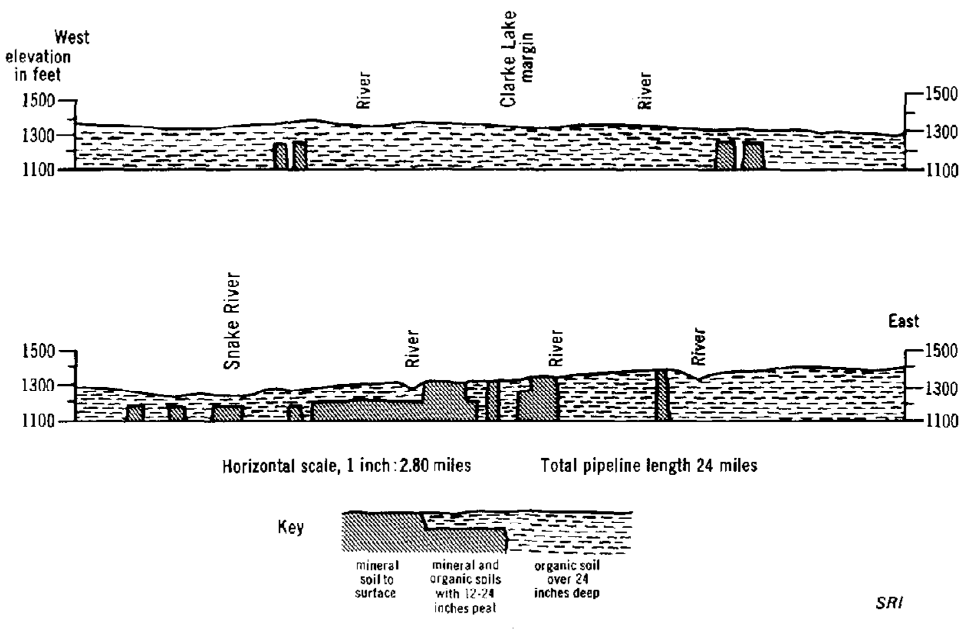


Fig. 5. Depth of organic terrain in the Clarke Lake region: cross section along a Westcoast Transmission Co. Ltd. pipeline survey.

The Sikanni Terrain System

The Sikanni terrain system includes the undulating plateau remnants that rise above the Buckinghorse terrain system. These remnants are composed of the brown sandstones and interbedded silty shales of the Sikanni formation. The unconsolidated surface mineral material is a dark brown clay loam with occasional gravel fragments. The portions of this terrain system which lie northwest of Fort Nelson and west of the Prophet River are rimmed by an escarpment that has slopes ranging from 10% to 20% where bedrock is occasionally exposed (Fig. 6). These plateau masses rise to over 2,000 ft above sea level and on the high points bedrock is often within 2 ft of the surface. The interior of the northwestern plateau is drained by sluggish streams in wide valleys, but near the escarpment the valleys become deeper and in places the streams have deposited fans where they flow onto the flatter Buckinghorse terrain system. Most of the slopes on the plateau are long and regular, ranging from 2% to 5%. Most of the surface material is mineral, but on the broad flat ridges and in the wide valleys shallow organic material, usually less than 3 ft thick, overlies the mineral substratum. In the northeastern corner of this plateau segment a narrow steep-sided meltwater overflow channel runs north from McConachie Creek.

The two parts of the terrain system shown (Fig. 4) east of the Prophet River and between the Fort Nelson and Snake rivers are slightly different. The Sikanni formation here is composed of interbedded sandstone, siltstone, and shale and does not form a marked peripheral escarpment. The highest elevation is just over 1,700 ft. However, apart from a thin veneer of sand from the neighboring Chuatse terrain

Fig. 6. The edge of the escarpment of the Sikanni terrain system. Clay loam till (1) overlies the Sikanni formation (2).

system in the south, the surface materials and morphology are the same as farther west.

The Chuatse Terrain System

The Chuatse terrain system comprises those sections where sand and gravel have been deposited over the plain of the Buckinghorse shales. The largest portion of this terrain system is in the northeastern part of the area. Sand caps the shales on the plateau bordering the Fort Nelson and Snake rivers, and the intervening portion shows parabolic dunes and eskerlike ridges protruding above the generally level land surface (Fig. 7). However, the extent of this northeastern part is not known exactly, as it was mapped by photo interpretation with little ground verification.

Sands and gravels also form the predominant mineral surface materials between the Prophet and Fort Nelson rivers north of Jackfish Creek, and in narrow strips along the plateau bordering the Muskwa River. In spite of the coarseness of these materials, the underlying shales and the flatness of the land severely limit surface water runoff. The actual surface material is therefore again predominantly organic, usually sphagnum peat. The only sections of deep, well-drained sands are found on the plateau edge immediately adjacent to the river valleys or on the dunes and eskerlike ridges. A unique feature on the plateau west of Muskwa is a large gravel bar between two old river channels.

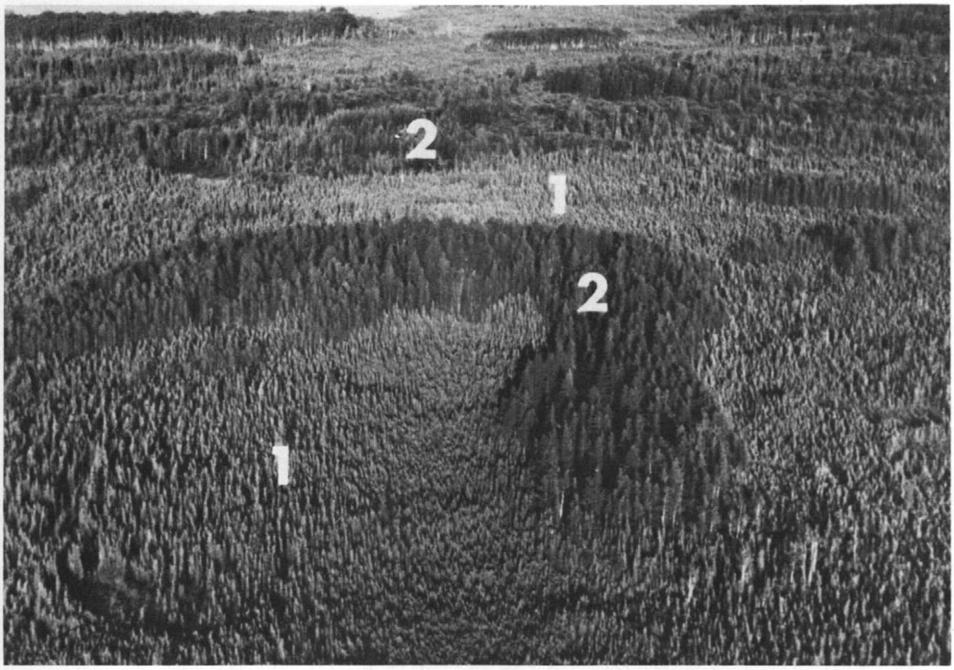


Fig. 7. Soil landscape of the Chuatse terrain system. In this region between the Snake and Fort Nelson rivers the very poorly drained Utahn soils support black spruce and sphagnum moss (1) and the Trail soils on sand ridges and parabolic dunes (2) have an open canopy of lodgepole pine.

The Muskwa Terrain System

The Muskwa terrain system includes the steep sides and terraced alluvial bottomlands of the Fort Nelson, Prophet, Muskwa, and Snake rivers (Fig. 8) plus the numerous remnants of previous channels that are incised to varying degrees into the plateau surface. These channel remnants are broad steep-sided cuts and have misfit streams and organic material in the bottom. Most of them are previous courses of the Fort Nelson River, showing that it once joined the Prophet and Muskwa rivers farther upstream. Jackfish Creek occupies one such channel, and the two channels on either side of the Muskwa gravel bar are other examples.

The valleys of the three principal rivers are entrenched 300 to 400 ft into the plateau. Their valley sides slope at angles ranging from 15% to 25%. The Snake River is only 200 ft below the plateau surface in the far north, but its valley sides are steeper. The upper slopes of these valleys are covered with a thin veneer of sand that has been washed down from the plateau edge. The lower slopes are covered with unstable colluvial silty clay derived from the underlying Buckinghorse shales. In places, especially along the Prophet River, the whole valley side is subject to large-scale slumping. This has also happened in the southeast along the Fort Nelson River where a burn has exposed the ground surface to excessive slopewash. In places along this same valley 200 to 300 ft of Buckinghorse shales are exposed.

In the constricted valley bottoms the rivers meander from side to side, producing a series of isolated alluvial terraces on alternate sides of the valley. There are usually three levels to these alluvial terraces; the highest upstream, the lowest

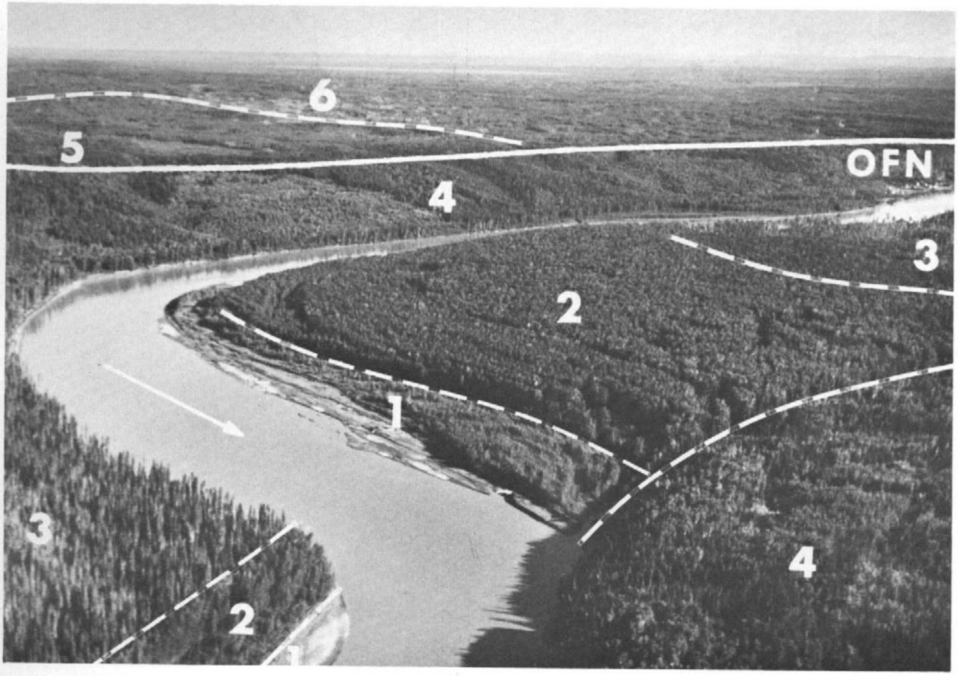


Fig. 8. Soil landscape of the Muskwa terrain system. Near Old Fort Nelson (OFN) the recent bars (1) have willows and small balsam poplar. The moderately well drained Snake soils on the middle terrace (2) support large balsam poplar and the imperfectly drained Prophet soils on the upper terrace (3) large white spruce. The Milo and Donaldson soils occur on the valley sides (4) under a mixed cover of trembling aspen or white spruce according to aspect, soil disturbance, or fire history. Exposures of Trail (5) and Klua soils (6) border the region.

downstream. The upper terrace lies about 20 to 25 ft above the river. It is composed of medium- to fine-textured alluvial deposits. The surface is gently undulating because of the old poorly defined meander scars. On the upstream side there is a steep river cliff subject to active erosion. Downstream it is fronted by a well-defined slope leading to the middle terrace 6 to 10 ft below. This terrace is composed of much coarser material and has well-defined meander scars that give it an irregular surface. The third and lowest level at the outer and downstream edges is formed of recent bar deposits of gravel and sand.

In places these terraces are dissected by sloughs representing abandoned courses of the river.

River floods, caused by seasonal snowmelt and accentuated by ice jamming, are an annual occurrence in this terrain system. However, the height and date of the maximum flood level varies from year to year. Gauging stations are in operation on the Muskwa River at Muskwa Bridge and on the Fort Nelson River near Old Fort Nelson. The Fort Nelson River station, in operation since 1961, has recorded maximum flood heights between 13.9 ft and 27.7 ft, on dates ranging from June 1 to August 3. The station on the Muskwa River has been in operation since 1945. The maximum recorded flood height has varied from 6 ft to 30.8 ft, on dates from May 6 to August 24. The levels of the Muskwa and Prophet rivers are also affected by water backing up at certain high stages of the Fort Nelson River.

From these figures and local information it is estimated that the recent bar deposits are completely flooded nearly every year, the middle terrace every 10 to 15 years, and the upper terrace only very rarely.

Vegetation

The surveyed area lies in the Upper Mackenzie and Upper Liard sections of the Boreal Forest Region (10). Drainage conditions are the principal influence on vegetation type. The general distribution pattern of the types is described in the following paragraphs. More detailed information is included in the soil descriptions.

The upper alluvial terraces are covered with a forest of dense white spruce, red-osier dogwood producing a very thick shrub layer. The coarser-textured lower terrace supports a balsam poplar forest with few shrubs but a thick carpet of woodland horsetail. These two vegetation types are quite distinct and do not often occur together. The vegetation on the valley slopes depends on moisture conditions controlled by aspect rather than by underlying material. On the drier south-facing slopes trembling aspen and mountain alder grow, whereas on the north-facing slopes the vegetation is principally white spruce and a thick mat of hypnum mosses, usually *Hylocomium splendens* (Fig. 9). This same pattern, due to aspect, is also found on any of the steeper slopes of the surrounding plateau lands, especially along the escarpment of the Sikanni terrain system.

Lodgepole pine is the principal tree on any of the deep sands. Labrador tea and mountain cranberry are the other two main plants.

On other soils on moderately well drained sites a thick forest of aspen occurs. Trees of secondary importance are white birch, white spruce, mountain alder, and at higher elevations alpine fir. White spruce becomes more common in slightly moister sites, and under imperfectly drained conditions it predominates over trembling aspen, mountain alder, and willow. The shrub and herb layer here is composed of wild rose, low bush-cranberry, and bunchberry. Hypnum mosses are also present. Where drainage conditions deteriorate further, black spruce appears as the predominant tree accompanied by willow, mountain alder, white spruce, and occasionally tamarack. The shrub layer is usually very limited, and the herb layer consists of a thick carpet of field horsetail over a predominantly hypnum moss layer.

The very poorly drained conditions of the flat organic terrain produce the most common vegetation type in the area. Black spruce 8 to 10 ft high grows sparsely over a surface of sphagnum and hypnum mosses. Labrador tea is a common shrub. It occasionally grows in large circular patches devoid of any trees. Tamarack, willow, and mountain cranberry are other common plants.

DESCRIPTIONS OF THE SOILS

The soils of the Fort Nelson area have been mapped and described according to the Canadian system of soil classification (8). The descriptions of the individual series and land types which follow are grouped according to terrain systems. The topographic position of the soils within each terrain system is shown by a cross-section diagram. A key to all the soils is included in Table 3. Soil colors are designated in the soil profile descriptions by the Munsell color system (*see* glossary). The letter d, m, or w after the Munsell notation denotes dry, moist, or wet color.

Table 3. The Soils and Land Types of the Fort Nelson Area

Name	Type of unit	Soil classification	Parent material	Drainage class	% of area
		The Buckinghorse Terrain System			
Fort Nelson	soil series	Orthic Gray Wooded	silty clay	moderately well drained	5.0
Hamilton	soil series	Gleyed Orthic Gray Wooded	silty clay to clay	imperfectly drained	2.1
Simpson	soil series	Carbonated Orthic Humic Gleysol	silty clay	poorly drained	2.1
Parker	soil series	Terric Fibric Mesisol	Mesic organic matter	very poorly drained	9.0
Klua	soil complex	Cryic Fibric Mesisol, and Cryic Fenno-Fibrisol	Mesic and Fibric organic matter	very poorly drained	39.0
		The Sikanni Terrain System			
Sikanni	soil series	Orthic Gray Wooded	clay loam with gravel	moderately well drained	8.8
Klowee	soil series	Rego Humic Gleysol	clay loam	poorly drained	4.3
McConachie	soil series	Terric Humic Fibrisol	Fibric organic material and silty clay	very poorly drained	7.1
Pouce	soil series	Orthic Regosol	loam with gravel	well drained	0.1
Jackfish	soil series	Brunisolic Gray Wooded	sandy loam and sand over clay loam	moderately well drained	1.0
Meltwater channels	land type				0.2
		The Chuatse Terrain System			
Trail	soil series	Degraded Dystric Brunisol	sand	well drained	3.0
Utahn	soil series	Rego Gleysol	sandy loam and sand	very poorly drained	4.0
Bar	soil series	Orthic Gray Wooded	sandy loam and sand with gravel	well drained	0.1
		The Muskwa Terrain System			
Donaldson	soil series	Orthic Gray Wooded	sand over silty clay	well drained	5.5
Milo	soil series	Orthic Regosol	silty clay and clay	imperfectly drained	2.6
Prophet	soil series	Cumulic Regosol	silt loam and silty clay loam	imperfectly drained	2.0
Snake	soil series	Cumulic Regosol	sandy loam and silt loam	moderately well drained	1.5
Abandoned river channels	land type				0.1
Recent bars	land type				0.2
Valley side slumps	land type				0.8

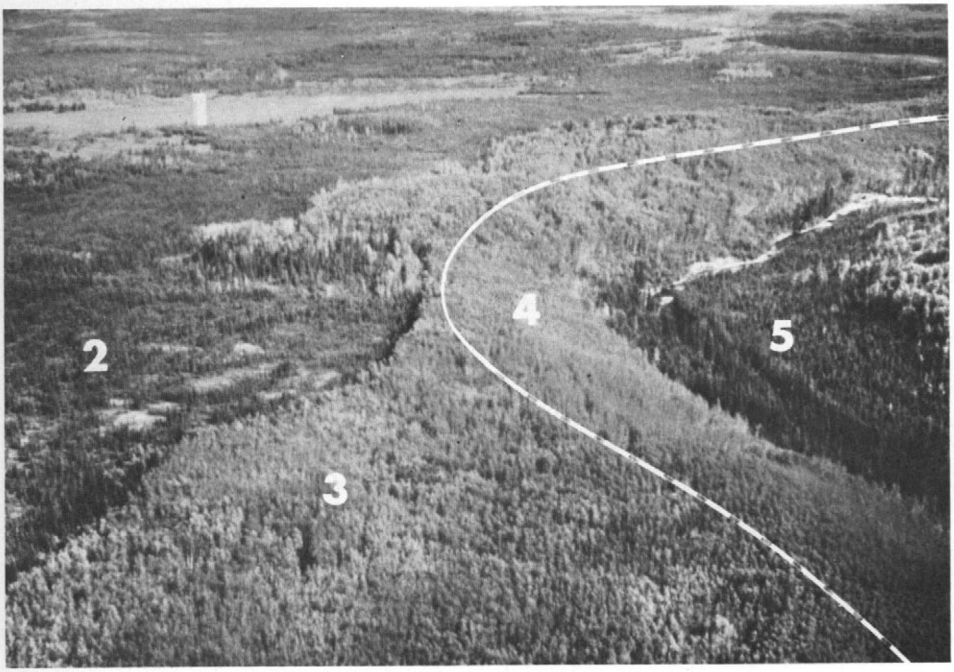


Fig. 9. The effect of aspect and topography. This view near the Snake River shows the very poorly drained Klua soils on the level topography (1) and the Simpson and some Parker soils on the very gently sloping land (2) nearer the valley. Fort Nelson soils occur on the moderately well drained gently sloping land bordering the valley (3) and on part of the south-facing slopes (4) under a cover of trembling aspen and mountain alder. The imperfectly drained foot and north-facing slopes (5) have Milo soils with white spruce and hypnum mosses.

Soils of the Buckinghorse Terrain System

This group of soils forms a catena, developed on silty clay derived principally from the soft Buckinghorse shales (Fig. 10). The range is from the moderately well drained Orthic Gray Wooded soils of the Fort Nelson series, to the very poorly drained Cryic Fibric Mesisol and Cryic Fenno-Fibrisol soils that together comprise the Klua complex. The intervening soils reflect the gradation of drainage within this range. A cross section of the terrain system showing the position of the soils is illustrated in Fig. 11.

Fort Nelson Series

The Fort Nelson soils occur on the gently sloping margins of the Buckinghorse terrain system or on the margins of the shallow river valleys that cross the plain. They occupy 38,470 acres, or about 5% of the total area. They are best developed north and west of Fort Nelson on the long slopes at the foot of the Sikanni sandstone escarpment. The soil parent material is dark gray silty clay. The soils are classified as Orthic Gray Wooded. A light brownish gray silt loam Ae horizon 6 inches deep overlies a dark brown Bt horizon approximately 20 inches deep in which clay has accumulated. This clay accumulation restricts soil drainage and the

Fig. 10. Soil landscape of the Buckinghorse terrain system. This view near Clarke Lake overlooks the moderately well drained Fort Nelson and imperfectly drained Hamilton soils with dominantly trembling aspen and white spruce (1), the poorly drained Simpson soils with stunted black spruce and sphagnum moss (2), and the very poorly drained Parker and Klua soils under a cover of sphagnum moss and Labrador tea (3).

upper part of the Bt is mottled. Roots penetrate to at least 47 inches. The silty clay C horizon contains numerous pockets of carbonate accumulation.

In spite of the fine-textured parent material the soils are moderately well drained and moderately permeable. Soil structure is strongly developed in the lower solum and this is maintained even when the soils are wet in the spring.

The vegetation is a dense forest of trembling aspen and white spruce with an understory of mountain alder. Red-osier dogwood, low bush-cranberry, rose, bunchberry, twinflower, and hypnum mosses are the predominant plants in the lower layers.

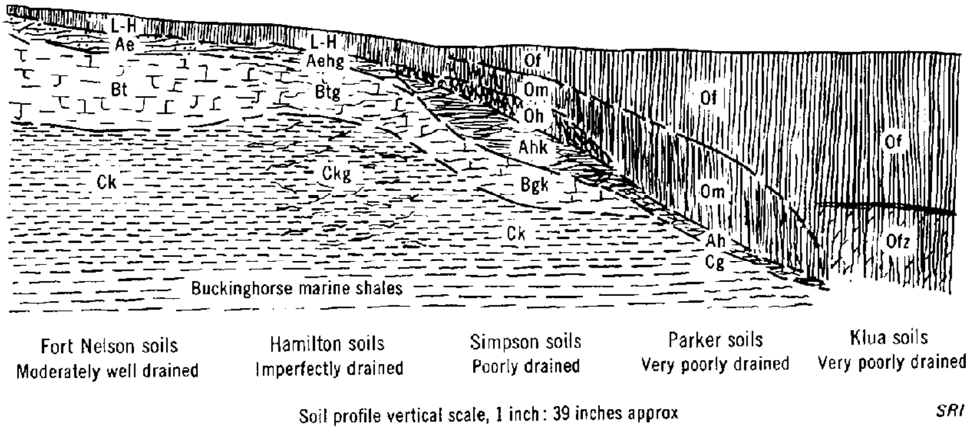


Fig. 11. Soils of the Buckinghorse terrain system.

The following description is of a soil 1 mile east of Fort Nelson at 58° 48′N 121° 41′W:

Horizon	*Depth inches*	
L-H	4 - 0	Semidecomposed organic matter; fibrous; very thick mat of living roots at base.
Ae1	0 - 1.5	Light brownish gray (10YR 6/2 m), light gray (10YR 7/2 d) silt loam; weak, fine platy; loose; abundant, medium and fine roots; abrupt, smooth boundary; medium acid.
Ae2	1.5 - 6	Light brownish gray (10YR 6/2 m) silt loam; weak, fine platy; friable; abundant, medium and fine roots; abrupt, smooth boundary; medium acid.
AB	6 - 8	Grayish brown (10YR 5/2 m) silty clay; few, faint, light yellowish brown mottles; moderate, medium subangular blocky; friable; plentiful, medium and fine roots; abrupt, smooth boundary; strongly acid.
Bt1	8 - 21	Dark grayish brown (10YR 4/2 m) silty clay; few, faint, light yellowish brown mottles; moderate, fine blocky; friable; plentiful, medium and fine roots; continuous, thin clay films, pores filled; gradual, irregular boundary; strongly acid.
Bt2	21 - 29	Very dark gray (10YR 3/1 m) silty clay; strong, fine blocky; very friable; common, medium and fine roots; discontinuous, thin clay films; abrupt, smooth boundary; slightly acid.
Ck	29 - 47 and below	Very dark gray (10YR 3/1 m) silty clay, with pockets of carbonate concentrations; strong, very fine, pseudo-blocky; very friable; few, fine roots; moderately calcareous; moderately alkaline.

The chemical and physical analyses of this soil are included in Table 4. The pH of the upper solum is 5.0. Accumulation of $CaCO_3$ causes the pH of the Ck to rise to 7.8. The organic matter content ranges from 1% to 2% throughout the solum and base saturation is 100% or a little less.

Where the slopes flatten to about 2%, these soils grade into the Hamilton soils.

Hamilton Series

The Hamilton soils occupy about 16,490 acres, or about 2.1% of the total area. They have developed from silty clay or clay parent materials on very gently sloping topography. They are classified as Gleyed Orthic Gray Wooded soils. The whole of the solum shows mottling or gleying. There is a very thick mat of living roots and decomposing organic matter on top of the mineral soil. A grayish brown silty clay loam horizon (Aehg) overlies an olive brown silty clay horizon (Btg), which grades into a dark gray clay (Ck). Weak or moderate soil structure is maintained into the lower solum even when the soil is high in moisture.

These soils are imperfectly drained and receive runoff from the Fort Nelson soils on the neighboring gently sloping topography. Soil permeability is moderate due to the stability of soil structure.

White spruce is the predominant tree in the forest cover. White birch, balsam poplar, and trembling aspen are secondary species; willow and mountain alder form a thick understory. Rose, low bush-cranberry, bunchberry, twinflower, peavine, and hypnum and mnium mosses are the main plants in the dense shrub and herb layer.

A soil sampled 1 mile south of Fort Nelson at 58° 47′N 122° 43′W is described as follows:

Horizon	*Depth inches*	
L-H	5 - 0	Semidecomposed organic matter; fibrous; thick living root mat; slightly acid.
Aehg	0 - 4	Dark grayish brown (10YR 4/2 m) silty clay loam; common, medium, faint, pale brown mottles; weak, fine subangular blocky; friable; plentiful, fine and medium roots; abrupt, smooth boundary; medium acid.
Btg	4 - 17	Light olive brown (2.5Y 5/4 m) silty clay, with pockets of loamy fine sand; common, medium, distinct, brownish yellow mottles and faint gleying (5BG 4/1); weak, fine subangular blocky; friable; few, medium and fine roots; continuous, thin clay films; gradual, irregular boundary; neutral.
Ckg	17 - 60 and below	Very dark gray (10YR 3/1 m) clay; fine, distinct, light yellowish brown mottles and faint gleying (5BG 4/1); moderate, fine pseudo-blocky; friable; few, fine roots to 32 inches; weakly calcareous; few rounded gravel fragments; mildly alkaline.

The chemical and physical analyses for this soil are shown in Table 4. The pH of the mineral soil increases from 5.4 in the Aehg horizon to 7.7 in the Ck, but hydraulic conductivity does not indicate the presence of Na. Base saturation is 100% due principally to the occurrence of Ca. The organic matter content of the mineral horizons is highest in the Aehg (3.5%).

These soils grade into the Fort Nelson soils on the slightly steeper slopes and the Simpson soils on the flatter slopes.

Simpson Series

The Simpson soils occupy approximately 16,320 acres, or 2.1% of the total surveyed area. They are poorly drained soils on the very gently sloping land, which usually occurs at the foot of the long regular slopes from the edge of the Sikanni plateau. Surface runoff and soil permeability are restricted although there is some lateral seepage from the soils on the upper slopes. These soils are Carbonated Orthic

Humic Gleysols. The mineral surface is covered with a deep spongy layer of organic remains composed principally of living and semidecomposed hypnum mosses. A very dark gray silt loam (Ahk) 10 inches thick occurs over a gleyed silty clay loam (Bgk). The usual dark gray silty clay (Ck) of the Buckinghorse terrain system occurs below about 24 inches. All mineral horizons show strong effervescence.

Black spruce provides a low dense forest cover with white spruce, white birch, willow, and mountain alder as secondary tree species. The shrub and herb layer is very limited, giving an open appearance to the forest. Labrador tea and a thick layer of field horsetail commonly occur. Hypnum mosses form a continuous surface layer.

A sample of this soil just south of the Alaska Highway at Mile 308 (58° 51′N 122° 55′W) is described as follows:

Horizon	*Depth inches*	
Of	16 - 12	Mat of living and partially decomposed mosses; moist.
Om	12 - 2	Mat of semidecomposed organic material derived mainly from mosses; wet; mildly alkaline.
Oh	2 - 0	Black (10YR 2/1 w) amorphous organic material; flows when saturated; mildly alkaline.
Ahk	0 - 10	Very dark gray (10YR 3/1 w) silt loam; weak, fine subangular blocky; sticky; no roots; strongly effervescent; mildly alkaline.
Bgk1	10 - 12	Brown (10YR 5/3 w) silty clay loam; weak, fine subangular blocky; sticky; strongly effervescent.
Bgk2	12 - 22	Dark gray (10YR 4/1 w) silty clay loam; common, fine, distinct, light yellowish brown mottles and occasional gleying (5B 4/1); weak, fine subangular blocky; sticky; fine carbonate concretions; strongly effervescent; mildly alkaline.
Ck	22 - 36 and below	Very dark gray (10YR 3/1 w) silty clay; common gleying (5GY 4/1); weak, fine subangular pseudo-blocky; sticky; fine carbonate concretions; strongly effervescent; moderately alkaline.

Some soils mapped with this series are Orthic Humic Gleysols because they do not contain the secondary carbonate enrichment. There are also Rego Humic Gleysols bordering the Parker and Klua organic soils.

Parker Series

The Parker soils are the most common ones on the level land west and north of Fort Nelson. They occupy 69,310 acres, or 9.0% of the total area. They are classified as Terric Fibric Mesisols. An upper layer of yellowish brown partially decomposed hypnum and sphagnum mosses (Of) overlies moss, sedge, and wood material of more advanced decomposition (Om). The underlying mineral soil is a thin horizon of very dark gray silty clay (Ah) over brownish yellow clay (Cg) (Fig. 12).

These soils are very poorly drained. Water remains at or near the surface all year.

The soil surface is covered by hummocks of sphagnum and hypnum mosses, with Labrador tea, baked-apple berry, scrub birch, mountain cranberry, and bearberry the principal plants in the shrub and herb layer. The sparse tree cover is formed of stunted black spruce 10 to 13 ft high, with occasional willows, tamarack, and white birch.

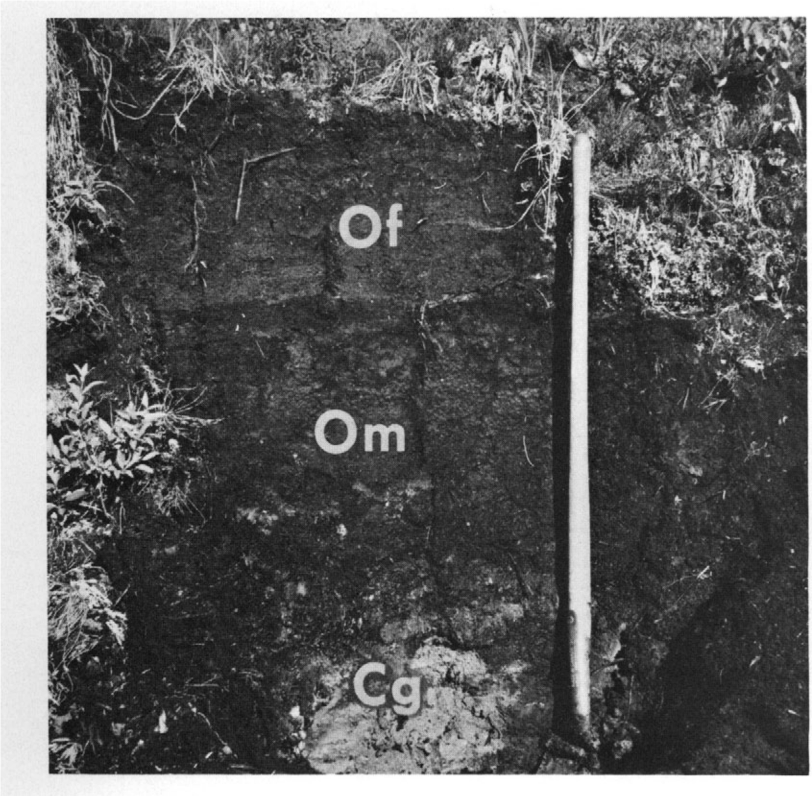


Fig. 12. Profile of a Parker soil near Parker Lake.

A soil examined near the road south to Parker Lake from Mile 307 on the Alaska Highway (58° 50'N 122° 54'W) is described as follows:

Horizon	*Depth inches*	
Of1	0 - 11	Yellowish brown (10YR 5/8 natural w), very pale brown (10YR 7/4 rubbed w) partially decomposed remains of sphagnum and hypnum mosses; fibrous; extremely acid.
Of2	11 - 22	Dark yellowish brown (10YR 3/4 natural w), very dark gray (10YR 3/1 rubbed w) partially decomposed remains of sphagnum and hypnum mosses; fibrous; slightly acid.
Om	22 - 42	Very dark gray (10YR 3/1 natural w), black (10YR 2/1 rubbed w) semidecomposed moss, sedge, and wood remains; slightly acid.
Of	42 - 43	Semidecomposed wood remains.
Ah	43 - 44.5	Very dark gray (10YR 3/1 w) silty clay; structureless; sticky; slightly acid.

Cg	44.5 - 60 and below	Clay, whole matrix either mottled (10YR 6/6 w) or gleyed (5BG 4/1); structureless; sticky; neutral.

The chemical and physical analyses of this soil are included in Table 5. The most important feature is the high acidity of the surface organic layer: pH 3.7.

The depth of the organic matter varies considerably within these soils. Bordering the Gleysolic Simpson soils the mineral material is much nearer the surface, giving a shallower Terric Fibric Mesisol. This is also true near any small stream. Occasionally the depth of organic material is greater than 64 inches, giving a Fibric Mesisol similar to that of the Klua complex. Cryic layers, however, were not found in the portion mapped as Parker soils.

Klua Complex

The Klua soils occupy 312,260 acres, or 39.0% of the total area, on the level land east of the Fort Nelson River. They are organic soils belonging to two great soil groups: Cryic Fibric Mesisol and Cryic Fenno-Fibrisol. It was impossible to predict their respective occurrence at the scale of this survey, either on a topographic or on a vegetation basis. Therefore, they are described and mapped together.

Both members of this complex are very poorly drained.

The Cryic Fibric Mesisol is the more common of the two members of this complex. It has an upper layer of yellowish brown partially decomposed moss material (Of1 and 2) and a lower layer 20 inches thick of dark brown moss and leaf remains that are at a more advanced stage of decomposition (Om). Beneath these layers less decomposed mosses and sedges occur to a depth of 60 inches, below which the material is frozen.

The principal forms of vegetation are an irregular surface layer of sphagnum and hypnum mosses, and Labrador tea, scrub birch, and occasional stunted black spruce and willow.

A soil sampled north of Clarke Lake at 58° 44′N 122° 29′W is described as follows:

Horizon	*Depth inches*	
Of1	0 - 2	Grayish brown (10YR 5/2 m) partially decomposed sphagnum and hypnum moss remains, plus some roots and fragments of charcoal.
Of2	2 - 13	Yellowish brown (10YR 5/8 natural m), yellow (10YR 7/6 rubbed m) partially decomposed sphagnum and hypnum moss remains; very strongly acid.
Om	13 - 34	Dark brown (10YR 3/3 natural m and rubbed m) semidecomposed moss and leaf remains; greasy; very strongly acid.
Of1	34 - 46	Yellowish brown (10YR 5/6 natural w), very pale brown (10YR 7/4 rubbed w) partially decomposed moss remains; medium acid.
Of2	46 - 60	Very dark grayish brown (10YR 3/2 natural w), light yellowish brown (10YR 6/4 rubbed w) partially decomposed moss and sedge remains; medium acid.

Ofz	60 - 64	Frozen layer of partially decomposed moss and sedge remains; slightly acid.

The chemical and physical analyses of the soil appear in Table 5. The most significant feature is the high acidity of the Of2 and Om layers, pH 3.9 and 4.3 respectively.

The whole profile of the Cryic Fenno-Fibrisol is composed of yellowish brown partially decomposed fibric material (Of). The color gradually darkens with depth. Hypnum and sphagnum moss remains are the most common material in the surface layer, but the sedge and wood content increases with depth. This latter material is predominant below 30 inches. When sampled, the soil was frozen below a depth of 40 inches.

The vegetation consists of a continuous irregular surface of hypnum and sphagnum mosses under Labrador tea and a sparse cover of stunted black spruce. Tamarack and mountain cranberry were also present.

A soil exposed along a road cut in the Clarke Lake gas field (58° 45′N 122° 26′W) is described as follows:

Horizon	*Depth inches*	
Of1	0 - 19	Yellowish brown (10YR 5/6 natural w), very pale brown (10YR 8/4 rubbed w) partially decomposed hypnum and sphagnum moss and sedge remains, plus living roots; extremely acid.
Of2	19 - 30	Yellowish brown (10YR 5/4 natural w), very pale brown (10YR 7/4 rubbed w) partially decomposed sedge and moss remains; extremely acid.
Of	30 - 40	Dark yellowish brown (10YR 4/4 natural w), brown (10YR 5/3 rubbed w) partially decomposed sedge and wood remains, plus occasional moss and charcoal layers less than 1 inch thick; strongly acid.
Ofz	40 - 53 and below	Frozen layer of partially decomposed sedge and wood remains; strongly acid.

Terric equivalents of these two soils are rare. The cross section along a pipeline of the Westcoast Transmission Co. Ltd. (Fig. 5) shows the organic material to be uniformly deep. However, the depth of the frozen layer and the depth of individual layers vary considerably.

Soils of the Sikanni Terrain System

The soils of the Sikanni terrain system are found on the undulating plateau formed by the Sikanni sandstones and shales. Three of them form a catenary sequence down the long regular slopes. These are the moderately well drained Sikanni soils (Orthic Gray Wooded) on the upper slopes, the imperfectly drained Klowee soils (Rego Humic Gleysol) on the lower slopes, and the very poorly drained McConachie soils (Terric Humic Fibrisol) in the level portions. A slope phase of the Sikanni soils occurs on the escarpment rimming the plateau and a shallow phase occurs on the summits. The Pouce soils are found on the fans developed by the streams flowing from the plateau onto the plain of the Buckinghorse terrain system. In the south the Jackfish soils occur where a thin cover of sand from the Chuatse terrain system overlies the clay loam material derived from the Sikanni sandstones and shales.

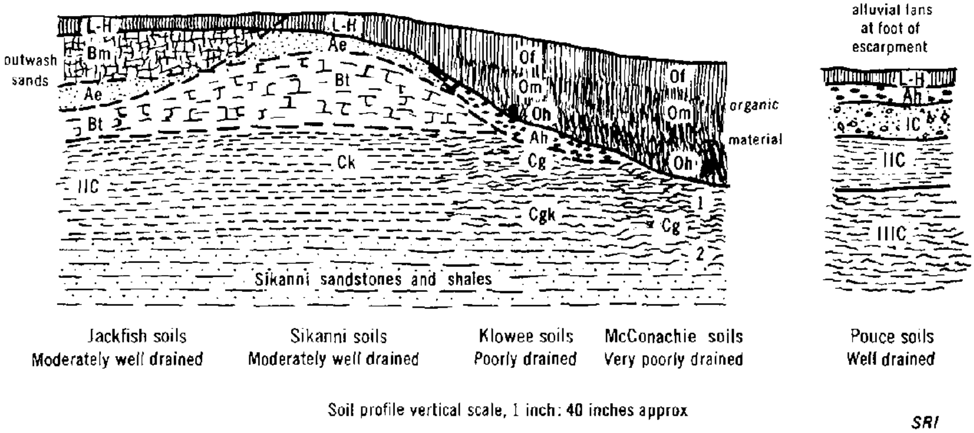


Fig. 13. Soils of the Sikanni terrain system.

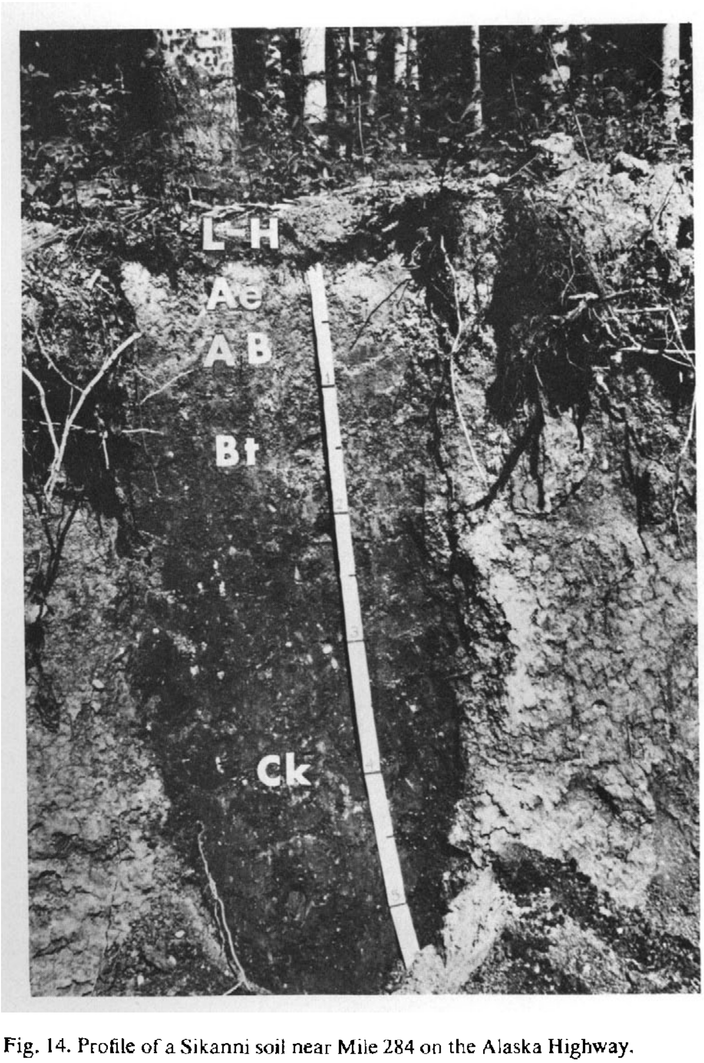


Fig. 14. Profile of a Sikanni soil near Mile 284 on the Alaska Highway.

Soil parent materials range from clay loam to silty clay loam. All contain some gravel fragments.

The topographic position of the soils is shown in Fig. 13.

Sikanni Series

The Sikanni soils occur on the moderately and gently sloping land. They occupy 69,440 acres, or 8.8% of the total area. They are Orthic Gray Wooded soils with a light gray silt loam surface horizon (Ae). This is underlain by a pale brown clay loam (AB) and a grayish brown clay (Bt), over a very dark gray clay loam (Ck) (Fig. 14). Gravel fragments occur throughout the profile.

These soils are moderately well drained and moderately permeable. Blocky soil structure is well developed into the Ck horizon and is maintained even under conditions of high soil water content in the spring.

The main trees in the dense forest cover are trembling aspen and mountain alder. White spruce, white birch, and at higher elevations alpine fir also occur. Rose, low bush-cranberry, bunchberry, twinflower, mountain cranberry, and occasional hypnum mosses form the main plants in the lower vegetation layers.

A soil sampled just west of the Alaska Highway at Mile 284 (58° 39′N 122° 43′W) is described as follows:

Horizon	*Depth inches*	
L-H	3 - 0	A layer of semidecomposed leaves, mosses, dead roots, and wood overlying a thick mat of living roots.
Ae	0 - 4	Light gray (10YR 7/2 m), white (10YR 8/2 d) silt loam; weak, fine subangular blocky; loose; abundant, fine, medium, and coarse roots; occasional subrounded gravel fragments; strongly acid.
AB	4 - 9	Pale brown (10YR 6/3 m), very pale brown (10YR 7/3 d) clay loam; moderate, fine subangular blocky; very friable; abundant, medium and fine roots; occasional subrounded gravel fragments; strongly acid.
Bt	9 - 22	Grayish brown (10YR 5/2) clay; strong, fine blocky; friable; plentiful, medium and fine roots; continuous clay films, pores filled; occasional, subrounded gravel fragments; strongly acid.
Ck	22 - 65 and below	Very dark gray (10YR 3/1) clay loam; weak, fine pseudo-platy and moderate, fine subangular pseudo-blocky; friable; few, fine and medium roots; fine carbonate coatings on peds, moderately calcareous below 30 inches; occasional gravel fragments; moderately alkaline.

The chemical and physical analyses for this soil are included in Table 4. The pH for the upper solum is around 4.0, but increases in the Ck to 7.8 owing to an accumulation of $CaCO_3$. Base saturation is 100% except in the Ae, and organic matter content is between 1% and 2% throughout the profile.

In places a Gleyed Orthic Gray Wooded soil occurs on the lower slopes bordering the poorly drained Klowee soils.

In the portion of the plateau northwest of Fort Nelson a shallow phase occurs on the summits, above about 2,000 ft. The same arrangement of soil horizons is found, but the horizons are compressed into less than 24 inches of unconsolidated mineral material that overlies highly weathered shale and sandstone. No profile description was taken of this shallow phase, and its distribution was not mappable at the scale used.

A slope phase of the Sikanni soils occurs on the escarpment slope that rims the plateau west of the Prophet River and northwest of Fort Nelson. The slopes range from 15% to 25%. The Orthic Gray Wooded soils are well drained on south-facing slopes that have a forest cover of trembling aspen. North-facing slopes have moderately well drained Orthic Gray Wooded soils that support a white spruce forest. A thick undergrowth of mountain alder, rose, bunchberry, twinflower, grasses, and moss restricts any potential downslope soil movement. No profile description of this slope phase was taken, but its distribution is shown on the map by the symbol overlay for slopes of 15% to 30% in the Sikanni soils.

Klowee Series

The Klowee soils occur on the very gently sloping land. They occupy 32,900 acres, or approximately 4.3% of the total area. They are Rego Humic Gleysols. A layer of semidecomposed moss and root remains (Of, Om) forms the surface over a black amorphous, well-decomposed organic layer (Oh). This overlies a black silty clay loam horizon (Ah) and a light olive brown clay loam (Cg), which is calcareous at depth (Cgk).

The soils are poorly drained and slowly permeable because of the fine-textured parent materials and almost level topography. Some lateral seepage occurs from the neighboring Sikanni soils.

The vegetation includes a continuous carpet of hypnum mosses under an open forest of short black spruce and willow. Rose, mountain cranberry, and horsetail form the shrub and herb layers.

A soil on the plateau 2 miles north of the Alaska Highway at Mile 312 (58° 54′N 122° 59′W) is described as follows:

Horizon	*Depth inches*	
Of	16 - 12	Spongy layer of living and partially decomposed hypnum mosses and roots.
Om	12 - 5	Dark brown (10YR 3/3 m) semidecomposed moss and root remains; greasy; neutral.
Oh	5 - 0	Black (10YR 2/1 m) amorphous organic material with some silt- and clay-sized mineral particles; greasy; neutral.

Ah	0 - 3	Black (10YR 2/1 m) silty clay loam; weak, fine subangular blocky; firm; very few, fine roots; neutral.
Cg	3 - 9	Light olive brown (2.5Y 5/4) silty clay loam; common, fine, light yellowish brown mottles and common gleying (5BG 5/1); weak, fine subangular pseudo-blocky; firm; very few, fine roots; weakly effervescent; some gravel; mildly alkaline.
Cgk1	9 - 18	Light olive brown (2.5Y 5/4) clay loam; common, fine, light yellowish brown mottles and common gleying (5BG 5/1); weak, fine subangular pseudo-blocky; firm; no roots; carbonate coatings on peds, and moderately effervescent; some gravel; moderately alkaline.
Cgk2	18 - 30	Very dark gray (10YR 3/1 m) clay loam; common, coarse, light yellowish brown mottles; weak, fine subangular pseudo-blocky; firm; carbonate coatings on peds, strongly effervescent; some gravel; moderately alkaline.

In level places the organic material deepens and this soil grades into the McConachie soils.

McConachie Series

The McConachie soils occur on the level portions of the broad stream valleys and rounded summits. They cover 55,070 acres, or about 7.1% of the total area. They are shallow organic soils classified as Terric Humic Fibrisols. A grayish brown layer of semidecomposed moss, sedge, and root remains overlies a black layer of well-decomposed amorphous organic material (Oh). The mineral soil underneath is a dark gray silty clay with patches of mottling and gleying (Cg).

The soils are very poorly drained as a result of the level topography, the fine-textured parent materials, and a seasonally frozen section within the Oh layer. Free soil water lies at or near the surface all year.

The vegetation is a continuous layer of hypnum and sphagnum mosses under an open forest of short black spruce, willow, and occasional tamarack. Labrador tea, scrub birch, mountain cranberry, horsetail, sedges, and grasses form the shrub and herb layer.

A soil sampled 2 miles north of the Alaska Highway at Mile 312 (58° 54′N 122° 59′W) is described as follows:

Horizon	*Depth inches*	
Of	24 - 14	Very dark grayish brown (10YR 3/2 natural w), yellowish brown (10YR 5/4 rubbed w) partially decomposed fibric material composed of sedges, hypnum and sphagnum mosses, and roots; neutral.
Om	14 - 9	Very dark grayish brown (10YR 3/2 natural w), brown (10YR 4/3 rubbed w) semidecomposed mesic sedge, moss, and root material; neutral.
Oh	9 - 0	Black (10YR 2/1 w) amorphous, decomposed organic material; neutral.
Cg1	0 - 10	Dark grayish brown (10YR 4/2 w) silty clay; common, distinct, light yellowish brown mottles and gleying (5BG 5/1); weak, fine subangular pseudo-blocky; abundant, fine roots; some gravel; neutral.

Cg2	10 20 and below	Very dark gray (10YR 3/1 w) silty clay loam; common, yellowish brown mottles and gleying (5BG 5/1); flows when saturated; no roots; weakly calcareous; mildly alkaline.

The chemical and physical analyses for this soil are included in Table 5. The most significant feature is the pH, which ranges from 6.3 to 7.2. These soils are much less acid than the deeper Parker and Klua organic soils of the Buckinghorse terrain system because of the influence of the underlying calcareous unconsolidated mineral material.

The depth of the organic material within these soils varies from 24 to 48 inches, and the Oh layer did not consistently include a frozen section at the time of the survey.

Pouce Series

The Pouce soils occur on the alluvial fans at the foot of the Sikanni escarpment west of Fort Nelson. They are of very limited extent, covering only 390 acres, or 0.1% of the total area. They are Orthic Regosols with a dark gray silt loam surface horizon (Ah) overlying a series of grayish brown coarse-textured horizons containing varying amounts of shale and sandstone fragments (C, IIC, and IIIC). The gravelly fan material is underlain by the dark gray silty clay of the Buckinghorse terrain system.

The topography is undulating, and low ridges down the fans give local relief of 5 to 8 ft.

The soils are well drained and highly permeable.

The vegetation is a dense forest cover of white birch, trembling aspen, and balsam poplar under which mountain alder, red-osier dogwood, low bush-cranberry, and rose form a very thick understory. Horsetail and bunchberry are the only plants in the herb layer.

A soil sampled at Mile 308 on the Alaska Highway (58° 51′N 122° 55′W) is described as follows:

Horizon	*Depth inches*	
L-H	3 - 0	Mat of partially decomposed leaves and needles; neutral.
Ah1	0 - 1.5	Dark gray (10YR 4/1 m) very fine sandy loam; weak, fine subangular blocky; very friable; abundant, medium and fine roots; medium acid.
Ah2	1.5 - 4	Dark gray (10YR 4/1 m) silt loam; single grain; loose; abundant, medium and fine roots; rounded shale and sandstone gravel; medium acid.
C	4 - 11	Grayish brown (10YR 5/2 m) loamy sand; weak, fine subangular blocky; very friable; abundant, medium and fine roots; rounded shale and sandstone gravel; very strongly acid.
IIC	11 - 24	Grayish brown (10YR 5/2 m) very gravelly loamy coarse sand; single grain; loose; abundant, fine, plus few coarse tree roots; numerous gravel fragments of shale and sandstone; slightly acid.
IIIC1	24 - 44	Grayish brown (10YR 5/2 m) silt loam; fine, distinct, yellowish brown mottles; weak, fine pseudo-platy; friable; very few, fine roots; some shale gravel; medium acid.

IIIC2	44 - 60	Very dark gray (10YR 3/1 w) silt loam; flowing.

The chemical and physical analyses of this soil are included in Table 4. The pH ranges from 4.4 in the upper C horizon to 6.5 in the overlying organic material. Base saturation is over 80% in all horizons and the organic matter content decreases from 4.3% in the Ah to less than 2% in the upper C horizon.

The depth of the gravel fans varies considerably. At the sample site 300 yards from the escarpment a bulldozer cut showed the gravel to be 8 ft thick.

Jackfish Series

The Jackfish soils occur only in that portion of the Sikanni terrain system which lies between the Fort Nelson and Prophet rivers. Here the plateau is low and undulating and a thin capping of sands from the neighboring Chuatse terrain system has been washed over the clay loam subsoil. These soils occupy 7,560 acres, or about 1.0% of the total area. They are Brunisolic Gray Wooded soils with 5 inches of semidecomposed organic matter on the surface. A yellowish brown very fine sandy loam horizon (Bm) 16 inches deep overlies 3 inches of brownish gray coarse sand (Ae). A grayish brown clay (Bt) and a dark grayish brown clay loam (IIC) are the horizons of the lower solum formed from the usual Sikanni soil parent material.

The surface sands are well drained, but soil drainage is restricted by the clay Bt, which contains fine mottles. The whole solum is moderately well drained at best and moderately permeable.

The vegetation is a dense forest cover of trembling aspen and white spruce over an almost continuous hypnum moss layer. Rose, mountain alder, bunchberry, and low bush-cranberry are the main plants in a thick understory.

A soil 1 mile north of Jackfish Creek at Mile 279 on the Alaska Highway (58° 36′N 122° 39′W) is described as follows:

Horizon	*Depth inches*	
L-H	5 - 0	Semidecomposed organic matter; fibrous; mat of living roots at base.
Bm	0 - 16	Yellowish brown (10YR 5/4 m) very fine sandy loam and coarse sand; very friable; abundant, fine and medium roots.
Ae	16 - 19	Light brownish gray (10YR 6/2 m) coarse sand; weak, fine platy; very friable; plentiful, fine and medium roots; some gravel.
Bt	19 - 24	Dark grayish brown (10YR 4/2 m) clay; few, fine, yellowish brown mottles; moderate, fine blocky; firm; plentiful, fine and medium roots; thin, discontinuous clay films.
IIC	24 - 30 and below	Very dark grayish brown (10YR 3/2 m) clay loam; moderate, fine pseudo-blocky; firm; very few, fine roots; very weakly effervescent; some gravel.

The depth of the overlying sands in these soils is very variable, and occasionally some interfingering takes place with alternate layers of clays and sands. Where the sands are shallow, the soils are Orthic Gray Wooded with coarse-textured Ae horizons; but where they are deep, the soils are weakly developed Brunisolic Gray Wooded grading into the Trail soils of the Chuatse terrain system.

Meltwater Channels

A number of expanses of this land type have been mapped in the plateau north of Fort Nelson. All are part of a long narrow trough running from north to south, which is cut by rivers flowing from the west. The sides are steep, often over 60%, they have numerous exposures of sandstones and shales, and in the north are over 200 ft high. The bottom of the trough is flat and occupied by lakes, streams, or organic deposits. At its southern end the channel splits into a number of diverging branches that merge into the Sikanni soils just south of McConachie Creek.

Soils of the Chuatse Terrain System

The soils of the Chuatse terrain system have developed on the sands and gravels that overlie the silty clay surface of the Buckinghorse shales (Fig. 7). Two soils are members of a catena. Degraded Dystric Brunisols (Trail series) have developed on deep well-drained sands, and Rego Gleysols (Utahn series) are found where level topography and the underlying silty clay restrict soil drainage. The Bar soils are found in only one locality, near Muskwa, where an Orthic Gray Wooded profile has developed on a large gravel deposit between two channel remnants. The main concentration of these soils is in the northeastern corner of the area and between the Prophet and Fort Nelson rivers north of Jackfish Creek. Fig. 15 is a cross section showing their relative positions.

Trail Series

The Trail soils cover approximately 22,400 acres, or 3.0% of the total area. They occur principally in the northeastern corner of the area where deep sand deposits flank the Fort Nelson and Snake rivers, but elsewhere they are common on numerous isolated sandy erosion remnants where soil drainage is not restricted. The topography is undulating, and very irregular in places where reworking by wind or subsequent erosion has produced a complex of slopes. These soils are Degraded

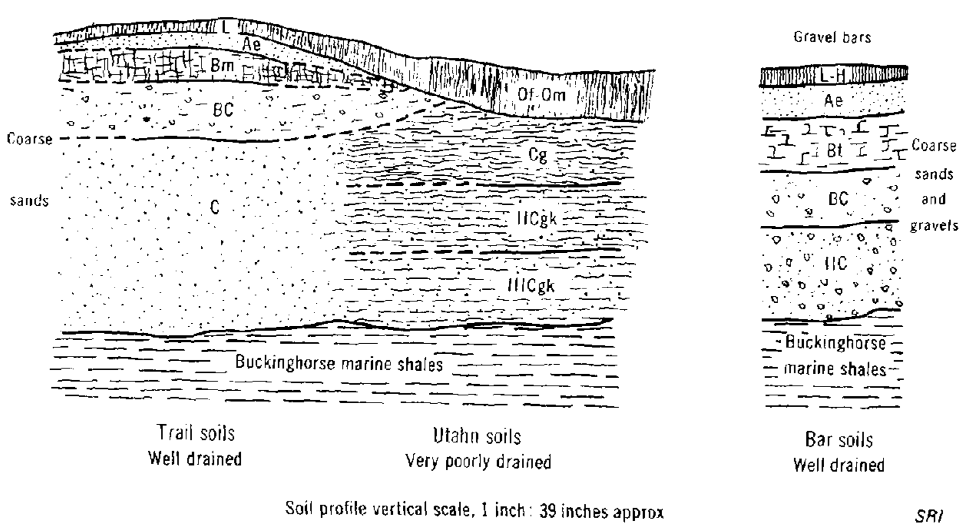


Fig. 15. Soils of the Chuatse terrain system.

Dystric Brunisols with a white sand surface horizon (Ae). This is underlain by a brown sand (Bf) over a very pale brown coarse sand (BC), over a pale yellow coarse sand (C). The last horizon occasionally contains very thin layers of loam.

The soils are well drained and permeability is high.

Lodgepole pine is the principal tree in the sparse forest cover. Labrador tea, bunchberry, mountain cranberry, twinflower, and lichens are the main plants in the shrub and herb layers.

A soil on a sand ridge near Mile 286 on the Alaska Highway (58° 40′N 122° 41′W) is described as follows:

Horizon	*Depth inches*	
L	1 - 0	Thin layer of partially decomposed needles, lichens, and wood.
Ae	0 - 4	White (10YR 8/1 m and d) sand; weak, fine platy; very friable; abundant, fine and medium roots.
Bm	4 - 12	Strong brown (7.5YR 5/8 m, 10YR 7/4 d) sand; single grain; very friable; plentiful, medium and fine roots.
BC	12 - 24	Very pale brown (10YR 7/4 m) coarse sand; single grain; very friable; few, fine and medium roots.
C	24 - 44 and below	Pale yellow (2.5Y 7/4 m) coarse sand; single grain; very friable; no roots. At depths of 36 and 38 inches two 1/2-inch-thick layers of loam occur.

A Brunisolic Gray Wooded profile containing numerous thin layers of fine material (Bt horizon) in the lower sand horizons sometimes occurs within these soils. Near the level land of the Utahn soils a Gleyed Degraded Dystric Brunisol is present.

Utahn Series

The Utahn soils occur on the level to very gently sloping land of the Chuatse terrain system. They occupy 30,000 acres, or 4.0% of the total area, and are classified as Rego Gleysols. They have a surface layer of semidecomposed sphagnum and hypnum mosses underlain by a brown sandy loam (Cg) and a yellowish brown sand (Cgk).

The soils are very poorly drained because of the level topography, the underlying Buckinghorse shales, and occasional ice lenses in fine-textured mineral layers. Soil permeability is very low.

The vegetation cover is an open forest of small black spruce with the occasional tamarack and willow. Labrador tea, horsetail, and hypnum and sphagnum mosses form a continuous ground cover.

A soil sampled at Mile 291 on the Alaska Highway (58° 43′N 122° 42′W) is described as follows:

Horizon	*Depth inches*	
Of-Om	10 - 0	Layer of semidecomposed hypnum and sphagnum mosses and living roots; strongly acid.
Cg	0 - 13	Brown (10YR 5/3 w) sandy loam; common, distinct, yellowish brown mottles; single grain; flows when saturated; few, fine and medium roots; mildly alkaline.
Cgk	13 - 17	Brown (10YR 5/3 w) sandy clay loam; single grain; flows when saturated; few, fine roots; weakly effervescent; mildly alkaline.

IICgk	17 - 32	Gray (10YR 5/1 w) loam; common, distinct, brownish yellow mottles and gleying (5BG 4/1); weak, fine subangular pseudo-blocky; no roots; moderately effervescent; mildly alkaline.
IICgk	37 - 42 and below	Yellowish brown (10YR 5/4 w) sand; single grain; flows when saturated; moderately effervescent; mildly alkaline.

These soils grade into the Trail soils where reworking of the sand by wind or water has produced islands of well-drained sand mounds a few feet above the general level of the plain.

Bar Series

The Bar soils occupy a level gravel deposit west of Muskwa. This is the only occurrence of these soils in the area. They cover 960 acres, or 0.1% of the total area. They are Orthic Gray Wooded soils and have a light brown silt loam horizon (Ae) over a brown gravelly clay loam (Bt), over a reddish brown very gravelly coarse sand (C).

The soils are well drained and permeability is high.

The vegetation over most of this gravel deposit is second-growth trembling aspen forest after a recent burn. White spruce and willows also occur. The shrub and herb layer is composed mainly of russet buffaloberry, low bush-cranberry, fireweed, strawberries, and grasses.

A soil exposed in a gravel pit north of the Muskwa maintenance camp (58° 46′N 122° 41′W) is described as follows:

Horizon	*Depth inches*	
L-H	4 - 0	Layer of semidecomposed organic material with thick root mat at base; charcoal very common in lower 2 inches.
Ae1	0 - 3	Brown (7.5YR 5/4 m, 6/4 d) silt loam; moderate, fine subangular blocky; friable; plentiful, coarse, medium, and fine roots; rounded gravel and cobbles.
Ae2	3 - 9	Light brown (7.5YR 6/4 m, 7/4 d) very fine sandy loam; weak, fine subangular blocky; friable; plentiful, coarse, medium, and fine roots; rounded gravel and cobbles.
Bt	9 - 18	Brown (7.5YR 5/4 m) gravelly clay loam; weak, fine subangular blocky; very friable; plentiful, medium and fine roots; moderately thick, continuous clay films; rounded gravel and cobbles 40-50% of soil material.
BC	18 - 30	Brown (10YR 4/3 m) gravelly loamy coarse sand; single grain; loose; few, fine and medium roots; few, thin clay films; rounded gravel and cobbles 50-60% of total soil material.
IIC	30 - 59 and below	Reddish brown (2.5YR 5/4) very gravelly coarse sand; single grain; loose; few, fine roots; carbonate coatings on gravel; moderately effervescent; rounded gravel and cobbles 50-70% of total soil material.

Soils of the Muskwa Terrain System

Two of the soils of the Muskwa terrain system, the Milo and Donaldson, occur on the valley slopes and two, the Prophet and Snake, occur on the upper and middle alluvial terraces. The Donaldson soils occur on the upper slopes where a layer of sands from the Chuatse terrain system has been washed over the clays. These sands gradually wedge out to leave the Milo clay and silty clay soils on the lower slopes. In places the instability of these clay slopes has caused slumping; the slumps are mapped as a land type. In the alluvial valley bottoms the Prophet soils occur on the medium-textured upper terrace and the Snake soils occur on the sandy middle terrace. The lower terrace level is formed by recent sand and gravel bars and is mapped as a land type, as are the numerous abandoned channels within the terraces. Fig. 16 is a cross section showing the relative position of these soils (*see also* Fig. 8).

Donaldson Series

The Donaldson soils are found on the upper slopes of the main river valleys. They occupy 42,130 acres, or about 5.5% of the total area. They are Orthic Gray Wooded soils developed on sands of variable thickness overlying weathered clay material from the Buckinghorse shales. A pale brown loamy sand horizon (Ae) overlies a brown silty clay horizon (Bt). The subsoil is composed of interfingering layers of calcareous gray sands (Ck) and dark gray clays (IICk).

These soils are well drained and moderately permeable. Where the sand becomes thin the soils are moderately well drained.

On drier south-facing slopes the dominant tree in the forest cover is trembling aspen. On moist north-facing slopes it is white spruce. White birch and mountain alder also occur. Rose, twinflower, bunchberry, low bush-cranberry, and a thick carpet of hypnum mosses form the lower vegetation layers.

A soil exposed by a road cut near Muskwa (58° 45′N 122° 39′W) is described as follows:

Horizon	*Depth inches*	
L–H	2 - 0	Mat of living and partially decomposed roots and leaves.
Ae	0 - 7	Very pale brown (10YR 8/3 d) loamy sand; fine, weak platy; loose; abundant, fine, medium, and coarse roots; abrupt, smooth boundary.
AB	7 - 9	Very pale brown (10YR 7/4 d) sandy loam; moderate, fine subangular blocky; very friable; abundant, fine and medium roots; abrupt, smooth boundary.
Bt	9 - 14	Brown (10YR 5/3 m) silty clay; moderate, fine blocky; very friable; plentiful, fine roots; continuous, thin clay films; abrupt, smooth boundary.
BCk	14 - 22	Dark gray (10YR 5/1 m) silty clay; moderate, fine blocky; plentiful, fine roots; carbonate concretions; strongly calcareous.
Ck	22 - 28	Gray (10YR 5/1 m) loamy sand; single grain; loose; plentiful, fine roots; moderately calcareous; abrupt, smooth boundary.
IICk	28 - 44	Dark gray (10YR 4/1 m) clay; strong, fine pseudo-blocky; very friable; plentiful, fine roots; weakly calcareous.

The depth of the sands is very variable and interfingering of sand and clay lenses is common. A Bisequa Gray Wooded soil is sometimes found where the sands are over 2 ft deep. Mixing of soil horizons occurs because of soil creep and tree throw.

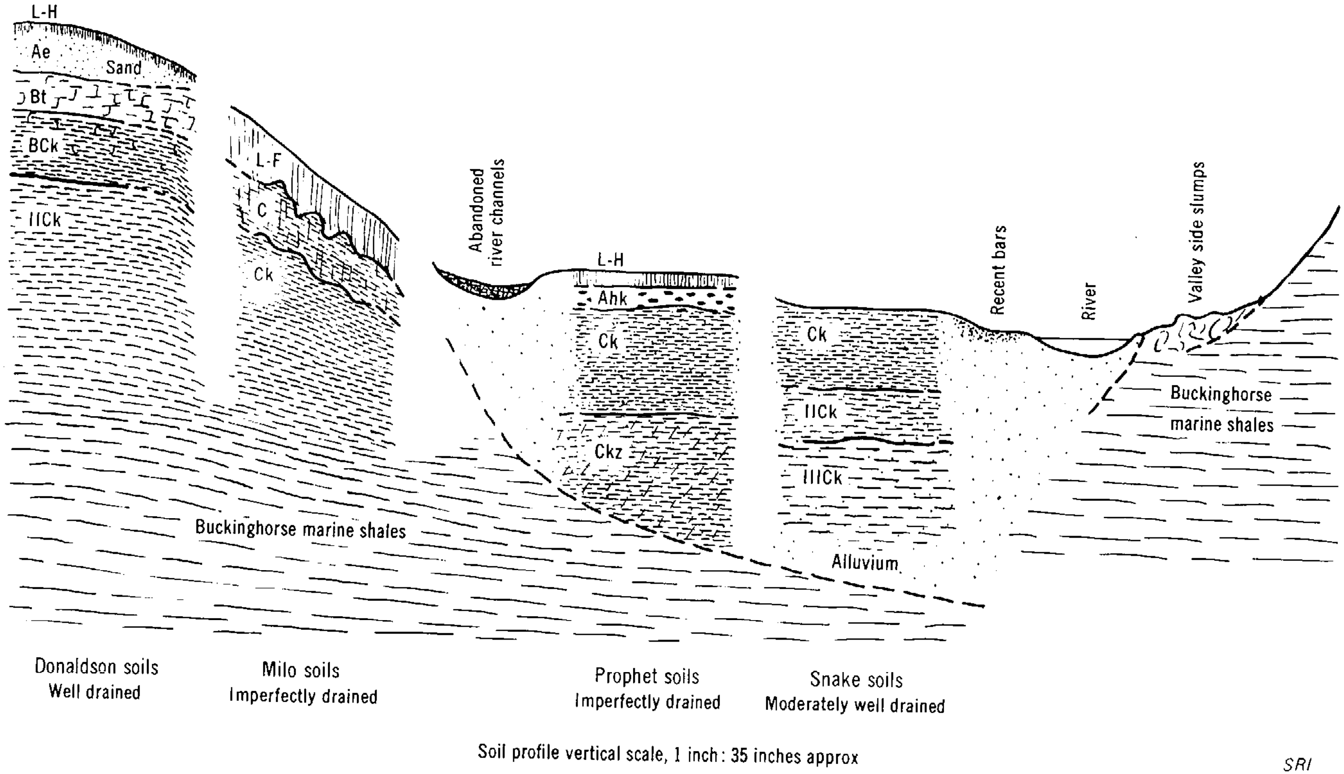


Fig. 16. Soils of the Muskwa terrain system.

Milo Series

The Milo soils are found on the lower portions of the steeply sloping sides of the main river valleys. They occupy about 19,700 acres, or 2.6% of the total area. They are Orthic Regosols formed on clay and silty clay derived from the Buckinghorse shales. This surface material is unstable, and mixing of soil horizons is common because of soil creep, large-scale slumping, and tree throw. The thick surface layer of hypnum mosses overlies a dark gray silty clay (C). The subsoil is a moderately calcareous black clay (Ck), which includes patches of decomposed organic material.

The soils are imperfectly drained and of low permeability.

On these moist lower slopes the dominant tree is white spruce regardless of aspect. White birch, trembling aspen, and balsam poplar also occur. Rose, squashberry, bristly currant, bunchberry, twinflower, and a thick layer of hypnum mosses form the lower vegetation layers.

A soil near Muskwa Bridge on the Alaska Highway (58° 47′N 122° 39′W) is described as follows:

Horizon	*Depth inches*	
L–F	10 – 0	Partially decomposed organic remains of moss, wood, and roots; some mixing with underlying mineral horizons due to soil creep and tree throw.
C	0 – 7	Very dark gray (10YR 3/1 m) silty clay; few, fine, faint, brown mottles; moderate, fine subangular blocky; slightly plastic; few, medium and fine roots; gradual, irregular boundary; includes patches of semidecomposed organic material and charcoal.
Ck1	7 – 24	Black (10YR 2/1 m) clay; moderate, fine blocky; slightly plastic; few, fine roots; some gravel; gradual, irregular boundary; includes patches of decomposed organic material; moderately calcareous.
Ck2	24 – 36	Black (10YR 2/1 m) clay; strong, fine blocky; plastic; no roots; includes patches of decomposed organic material; strongly calcareous; some gravel.

Prophet Series

The Prophet soils occur on the irregular gently sloping land of the upper alluvial terraces. The surface of these terraces is between 20 and 30 ft above the low flood level of the main rivers. The soils occupy 15,450 acres, or approximately 2.0% of the total area. They are Cumulic Regosols with a litter layer of mosses, leaves, and wood over a moderately calcareous dark gray silt loam (Ahk). The subsoil is moderately calcareous dark gray silt loam (Ck). In some places the lower section of this horizon is frozen (Ckz).

The soils are imperfectly drained and moderately permeable.

The vegetation is a dense forest growth of white spruce with an understory of mountain alder. Rose, red-osier dogwood, low bush-cranberry, horsetail, bunchberry, and a discontinuous cover of hypnum mosses form the lower vegetation layers.

A soil sampled below Fort Nelson airport (58° 50′N 122° 32′W) is described as follows:

Horizon	*Depth inches*	
L-H	4 - 0	Slightly decomposed litter of moss, leaves, and wood.
Ahk	0 - 3	Very dark gray (10YR 3/1 m) silt loam mixed with some partially decomposed organic remains; weak, fine subangular blocky; very friable; abundant, fine, medium, and coarse roots; moderately calcareous; abrupt, smooth boundary; moderately alkaline.
Ck	3 - 25	Dark gray (10YR 4/1 m) silt loam with thin partially decomposed organic layers; weak, fine pseudo-platy; friable; plentiful, medium and fine roots; many, fine pores; moderately calcareous; abrupt, smooth boundary; moderately alkaline.
Ckz	25 - 36	Dark grayish brown (10YR 4/2 m) silt loam; frozen, small ice particles visible; weak, fine pseudo-platy; no roots; many, fine pores; moderately calcareous; moderately alkaline.

The analyses for this soil are included in Table 5. The pH of the mineral soils is around 7.5 for all horizons. The $CaCO_3$ equivalent ranges from 7.0% in the Ahk horizon to 11.7% in the Ckz. Base saturation is therefore 100% and the exchange complex is saturated with Ca. The organic matter content of the mineral soil is high: 9.8% in the Ahk and 7.5% in the Ck.

The thickness and texture of the horizons within these soils vary enormously from place to place owing to the variable forces of alluvial deposition and erosion. In the upper reaches of the Fort Nelson River the soils are often silty clay loams with buried layers of partially decomposed organic material. The surface of the mineral soil under the thick litter layer is lined with polygonal cracks owing to shrinkage of the soil on drying after a flood. The subsoil is not always frozen, and where the dense white spruce forest has been logged, any previously frozen layers thaw. Thus, although the soil sampled contains a frozen horizon, the soils in general are classified as Cumulic Regosols and not Cryic Cumulic Regosols.

Snake Series

The Snake soils occur on the irregular gently to very gently sloping land of the middle alluvial terrace in the valleys of the main rivers. They occupy about 12,340 acres, or 1.5% of the total area. The alluvium is coarser than that of the Prophet soils. The texture ranges from coarse sandy loam to silt loam. These soils are Cumulic Regosols. They are made up of dark gray silt loam and loam horizons (Ck) and grayish brown sandy loam horizons (Ck) whose exact arrangement and thickness vary considerably according to the depositional history of the alluvium. All horizons are moderately calcareous.

The soils are moderately well drained and moderately permeable.

The forest cover is a dense stand of tall balsam poplar with an understory of mountain alder and willow. Red-osier dogwood and rose form a dense shrub layer. The herb layer is dominated by a thick cover of horsetail. A soil sampled near Muskwa bridge (58° 47′N 122° 39′W) is described as follows:

Horizon	Depth inches	
L	1 - 0	Slightly decomposed litter of leaves and horsetail.
Ck1	0 - 2	Dark gray (10YR 4/1 m) silt loam; weak, fine platy; friable; plentiful, fine and medium roots; moderately calcareous; abrupt, smooth boundary; moderately alkaline.
Ck2	2 - 8	Dark gray (10YR 4/1 m) loam; weak, very fine pseudo-platy; very friable; plentiful, medium and fine roots; moderately calcareous; abrupt, smooth boundary; mildly alkaline.
Ck3	8 - 15	Dark gray (10YR 4/1 m) silt loam; common, fine, yellowish brown mottles; weak, fine pseudo-platy; very friable; plentiful, medium and fine roots; moderately calcareous; abrupt, smooth boundary; mildly alkaline.
IICk	15 - 22	Dark grayish brown (2.5Y 4/2 m) sandy loam; weak, very fine pseudo-platy; very friable; plentiful, medium and fine roots; moderately calcareous; abrupt, smooth boundary; mildly alkaline.
IIICk	22 - 60	Dark gray (10YR 4/1 m) loam; weak, very fine pseudo-platy; very friable; plentiful, fine and medium roots; moderately calcareous; abrupt, smooth boundary; mildly alkaline.

The soil analyses of this soil are included in Table 5. The pH is almost constant down the profile at 7.5. The $CaCO_3$ equivalent is also regular, ranging only from 9.9% to 13.1%. Base saturation is therefore 100% and the exchange complex is saturated with Ca. The organic matter content decreases with depth from 3.8% to 2.0%.

Polygonal cracks occur on the mineral soil surface as a result of shrinkage after flooding. Unlike the Prophet soils, no frozen layers were encountered in these soils.

Abandoned River Channels

This land type represents the former courses of the main rivers which have not yet been completely silted up and recolonized by vegetation. They remain stagnant sloughs separated from the river except at times of high flood. Most of them retain some water all year and their sloping sides are composed of bare fine-textured alluvium.

Recent Bars

This land type is composed of the sand and gravel most recently deposited by the river at the outer and downstream edges of the alluvial terraces. At its highest point it merges with the coarse- and medium-textured alluvium upon which the Snake soils have developed. From this point it descends in a series of arcuate bars to the level of the river. At its upper level it is colonized by young balsam poplar, willow, and horsetail. The vegetation decreases in height and density toward the river where the most recent bars are bare sand and gravel. The whole of this land type is flooded nearly every year.

Valley Side Slumps

The flat-lying Buckinghorse shales are subject to extensive slumping. Along all the main river valleys, especially along the Prophet River, large sections of the steep valley sides have slumped onto the alluvial flats. These slump sections have steep backwalls devoid of trees and very irregular hummocky topography at their feet where the slumped material has come to rest. Some show the backward-facing terraces typical of rotational slippage. Along the Fort Nelson River near Jackfish Creek the natural instability of the shale is increased by an extensive recent burn that has deprived the slopes of the normal protection of a dense vegetation cover.

METHODS OF SOIL ANALYSIS

The following methods were used to analyze the soil samples:

Texture: sand, silt, and clay. The pipette method was used. Kilmer, V. J., and L. T. Alexander. 1949. Soil Sci. 68:15-24.

pH ($CaCl_2$). Schofield, R. K., and A. W. Taylor. 1955. Soil Sci. Soc. Amer. Proc. 19:164-167.

Organic matter. Method of Peech, M., et al. 1947, given in Atkinson, H. J., et al. 1958. Chemical methods of soil analysis. Can. Dep. Agr. Chem. Div., Sci. Serv., Contribution 169. p. 16. Revised. For organic horizons, the samples were ashed at 400 C in a muffle furnace and organic matter content calculated as percent loss of weight.

Total N. Kjeldahl method given in Atkinson, op. cit. p. 20.

Easily soluble P. Bray method in Atkinson, op. cit. p. 25.

Easily soluble S. Johnson, C. M., and H. Nishita. 1952. Anal. Chem. 24:736-742.

Exchangeable cations. Clark, J. S. 1965. Can. J. Soil Sci. 45:311-322.

Cation-exchange capacity. The Na-saturated soil from the exchangeable cations determination was washed with 1 N NH_4Cl and the extracted Na was determined on an Atomic Absorption Spectrophotometer. Electrical conductivity. Saturated paste method, *in* Richards, L. A. [ed]. 1954. Diagnosis and improvement of saline and alkali soils. USDA Agriculture Handbook No. 60.

$CaCO_3$ equivalent. Schollenberger, C. J. 1958. Soil Sci. 85:10-13.

Oxalate-extractable Fe and Al. McKeague, J. A., and J. H. Day. 1966. Can. J. Soil Sci. 46:13-22.

SOIL INTERPRETATIONS FOR AGRICULTURE, FORESTRY, WILDLIFE, AND RECREATION

Soils and Agriculture

The soils of the area were rated according to their capability for supporting cultivated field crops or perennial forage crops. This section describes the basis for this classification, the capabilities of the individual soils described in the report, and the specific climatic and soil limitations to agriculture that occur within the area.

The method of rating used was the Soil Capability Classification for Agriculture, The Canada Land Inventory Report No. 2 (1). In this classification the mineral soils and land types are grouped into seven classes. The first three classes are considered capable of sustained use for field crops. Class 4 is marginal for sustained arable agriculture. Class 5 is capable of use only for permanent pasture and hay, and Class 6 is capable of use only for native pasture. Class 7 is not capable of supporting any form of agriculture. Classes are based on intensity rather than kind of limitations, and several different soils may have the same class. Land requiring improvements that can be made economically by the farmer himself is classified

Table 4. Analyses of Certain Soils in the Fort Nelson Area

Horizon	Depth inches	pH $CaCl_2$	Organic matter %	Total N %	Easily soluble		Exchangeable cations meq/100 g			Cation-exchange capacity meq/100 g	Base saturation %	Conductivity mmhos/cm	$CaCO_3$ equivalent %	Sand %	Silt %	Clay %	Texture
					P ppm	S ppm	Ca	Mg	Al								
								Fort Nelson Soils									
L-H	4 - 0	5.5	75.3	1.84	25	40.0											
Ae1	0 - 1.5	5.0	2.0	0.10	34	5.6	8.1	1.8	0.0	11.0	89.6	0.17	0.2	5.5	73.1	21.3	SiL
Ae2	1.5- 6	5.1	1.0	0.08	26	2.4	8.3	2.3	0.1	11.0	97.0	0.12	0.1	3.0	71.1	25.9	SiL
AB	6 - 8	5.0	1.0	0.09	22	2.0	12.2	4.5	0.1	15.1	100+	0.06	0.3	0.9	57.0	43.1	SiC
Bt1	8 -21	4.9	1.0	0.08	27	2.0	16.7	6.3	0.1	21.4	100+	0.05	0.4	0.7	51.9	47.4	SiC
Bt2	21 -29	5.9	1.7	0.10			16.2	6.8		21.2	100+	0.25	0.4	0.1	57.9	41.9	SiC
Ck	29 -47+	7.8	1.2	0.07			15.1	4.0		17.1	100+	0.24	9.5	2.9	57.9	39.2	SiCL
								Hamilton Soils									
L-F-H	5 - 0	5.7	68.8	1.84	81	26.4											
Aehg	0 - 4	5.4	3.5	0.18	17	14.4	19.9	4.5		24.6	99.4	0.40	0.0	9.7	53.1	37.2	SiCL
Btg	4 -17	6.4	1.3	0.08	100	22.8	15.8	4.1		18.5	100+	0.35	0.0	22.3	40.4	37.3	CL
Ckg	17 -60+	7.7	1.6	0.11		125.0	19.4	5.4		23.7	100+	1.09	5.4	2.7	36.3	61.1	C
								Sikanni Soils									
Ae	0 - 4	4.4	1.2	0.05	10	1.6	4.7	0.7	0.7	6.9	89.1	0.11	0.3	29.1	62.7	8.2	SiL
AB	4 - 9	4.0	1.1	0.08	1	1.2	6.5	2.5	6.6	14.7	100+	0.06	0.4	20.8	41.3	37.8	CL
Bt	9 -22	4.1	1.0	0.08	2	1.2	11.9	4.1	4.5	20.0	100+	0.04	0.4	18.3	37.4	44.3	C
Ck	22 -65+	7.8	1.7	0.10			14.8	3.7		15.6	100+	0.28	6.5	21.9	41.5	35.6	CL
								Pouce Soils									
L-H	3 - 0	6.5	81.3	2.54	44												
Ah1	0 - 1.5	5.6	4.3	0.26	44		11.5	1.6		14.1	93.1			30.3	45.6	24.1	L
Ah2	1.5- 4	4.8	2.1	0.17	19		8.5	1.6	0.1	12.6	84.6			38.3	39.2	22.6	L
C	4 -11	4.4	2.5	0.17	17		8.0	2.0	0.7	11.1	95.7			30.1	44.2	25.7	L
IIC	11 -24	5.6	1.9	0.15			10.0	2.0		13.8	87.3			39.6	37.0	23.4	L
IIIC1	24 -44	5.0	2.7	0.17			10.8	1.8	0.1	13.0	93.4			22.7	52.6	24.8	SiL

Table 5. Analyses of Certain Soils in the Fort Nelson Area

Horizon	Depth inches	pH $CaCl_2$	Organic matter %	Total N %	Easily soluble P ppm	Bulk density g/cc	Maximum H_2O capacity %	Unrubbed fiber %	Conductivity mmhos/cm	$CaCO_3$ equivalent %	Sand %	Silt %	Clay %	Texture
							Parker Soils							
Of1	0 -11	3.7	96.1	0.50		0.04	2,530	96						
Of2	11 -22	5.8	89.6	1.00		0.21	883	77						
Om	22 -42	5.9	72.2	2.08		0.18	520	38						
Of	42 -43													
Ah	43 -44.5	11.6		0.69							2.6	50.8	46.6	SiC
Cg	44.5+	1.2		0.11					0.33	0.2	1.1	35.3	63.6	C
							Klua Soils (Cryic Fibric Mesisol)							
Of1	0 - 2													
Of2	2 -13	3.9	94.4	0.89		0.16	1,656	87						
Om	13 -34	4.3	81.4	0.88		0.28	696	54						
Of1	34 -46	5.3	90.6	0.37		0.12	2,248	84						
Of2	46 -60	5.4	91.0	1.68		0.16	1,060	73						
Ofz	60 +	5.9	91.2	2.42				82						
							McConachie Soils							
Of	24 -14	6.6	83.6	1.20				86	0.35	0.0				
Om	14 - 9	6.9	67.7	1.81				43	0.31	0.0				
Oh	9 - 0	6.3	61.5	1.55	3			23	0.18	0.0				
Cg1	0 -10	6.9	0.9	0.12	167				0.14	0.0	3.6	54.8	41.6	SiC
Cg2	10 -20+	7.2	1.3	0.09					0.23	2.5	8.4	53.0	38.6	SiCL
							Prophet Soils							
L-H	4 - 0	5.1	80.8	1.64	24				0.42	7.0	4.4	69.9	25.7	SiL
Ahk	0 - 3	7.2	9.8	0.37	8				0.38	9.9	3.8	75.5	20.7	SiL
Ck	3 -25	7.6	7.5	0.24	31				0.37	11.7	1.8	75.4	22.8	SiL
Ckz	25 -36+	7.7	8.0	0.19										
							Snake Soils							
Ck1	0 - 2	7.6	3.7	0.16	12				0.47	13.1	16.4	72.1	11.4	SiL
Ck2	2 - 8	7.6	3.8	0.15	15				0.42	11.5	46.4	42.8	10.8	L
Ck3	8 -15	7.4	3.7	0.16	9				0.68	11.8	26.6	61.0	12.5	SiL
IICk	15 -22	7.4	3.7	0.15					1.90	9.9	54.2	34.0	11.8	SL
IIICk	22 -60	7.5	2.0	0.11					[illegible]					

according to its continuing limitations after the improvements have been made. Land requiring improvements beyond the means of the farmer is classified according to its present condition. Thus, in the Fort Nelson area, forested land where clearance is feasible has been classed as if the clearing were complete, whereas in the flat-lying poorly drained sections, where it would be impossible for a single farmer to drain the land effectively, the soils have been downclassed drastically because of their wetness.

The distance to markets, presence of roads, location, size of farms, type of ownership, cultural patterns, and the skill or resources of individual operators are not criteria used in this classification.

The climatic limitation to agriculture has been assessed by using the meteorological data from Fort Nelson airport and estimated data derived from the Hopkins regression formulas (12). From these data the monthly and annual mean daily maximum, mean daily minimum, and mean temperatures were calculated for a given location in the Canadian Great Plains using latitude, longitude, and elevation. Some of these data are included in Tables 1 and 2, on the basis of which elevation limits were set for the soil capability classes. These limits are based primarily on the frost-free season (32 F), the growing season, and the growing degree-days, as the precipitation, although low, is not a serious limitation.

Apart from these regional climatic limitations there are places such as valley bottomlands where frost hollows cause local climate hazards.

The elevation limits set for the capability classes are as follows:

Capability class	1	2	3	5
Elevation, feet	below 1,250	1,250–1,600	1,600–2,000	over 2,000
Frost-free season (32 F), days	>90	75–90	50–75	<50
Growing season (42 F), days	>155	150–155	145–150	<145
Growing degree-days	>2,200	2,200–1,900	1,900–1,650	<1,650

The capability classes assigned to each soil and land type over its elevation range are shown in Table 6. Specific limiatations are denoted by subclasses whose symbols are explained at the bottom of the table.

Limitations to Agricultural Use

Erosion. A number of the soils derived from clay or clay loam parent materials show evidence of actual or potential erosion. Severe erosion has occurred along the steep sides of the main river valleys where the Milo and Donaldson soils have disturbed surface layers because of active soil creep. Large landslide sections also occur in the unstable Buckinghorse shales of these valley sides. Potentially arable clay and silty clay soils such as the Fort Nelson and Hamilton soils usually occur on gently or very gently sloping topography where exposure of the surface by land clearing should not lead to much damage by sheetflooding. Locally, however, slopes range up to 10% and care should be taken not to expose long straight slopes. Sections of the forest vegetation should be left.

The Sikanni clay loam soils are more stable than the Fort Nelson or Hamilton soils. Where fires have exposed the surface soil especially on the peripheral escarpment slopes of the Sikanni terrain system, they are subject to active gully erosion and some slumping. Care should be taken not to expose long straight slopes of 8–10% or more by land clearing.

Inundation by streams. The land types and the Prophet and Snake soils mapped

Table 6. Soil Capability for Agriculture Ratings of the Soils of the Fort Nelson Area

Soil series or land type	Elevation in feet, and median climate class: below 1,250 (class 1)	1,250-1,600 (class 2)	1,600-2,000 (class 3)	over 2,000 (class 5)
Fort Nelson		3X, 4DF	4X	
Hamilton		4SW	5ST	
Simpson		6W, 7W	6W, 7W	
Parker		-	-	
Klua complex		-	-	
Sikanni		3X, 4DF	4X, 5ST, 6T, 7TR	5C, 6T, 7TR
Klowee		6W, 7W	6W, 7W	6W, 7W
McConachie		-	-	-
Pouce		5M	5M	
Jackfish		4MF	4MF, 5ST	
Meltwater channels		7T, 7W	7T, 7W	
Trail		4MF, 5M	4MF, 5M	
Utahn		6W, 7W		
Bar		5M		
Donaldson	7TE	4MF, 7TE		
Milo	7TE			
Prophet	2C (frost), 2X, 3SW			
Snake	3MI, 4MI			
Abandoned river channels	7W			
Recent bars	7I			
Valley side slumps	7TE			

Subclass symbols:
- C adverse climate
- E erosion
- I inundation by streams
- R consolidated bedrock
- T topography
- W excess water
- X cumulative minor adverse characteristics
- S adverse soil characteristics
- M moisture limitation
- F low fertility
- D undesirable soil structure, or low permeability, or both

in the bottomlands of the main river valleys are subject to river flooding caused by high runoff in spring and early summer and concomitant ice jamming. From data supplied by the Water Resources Branch of the Department of Energy, Mines, and Resources, Vancouver (see the description of the Muskwa terrain system), and from local evidence, it is apparent that the recent bars and probably most of the abandoned river channels are subject to annual flooding and are therefore of no agricultural use. The Snake soils on the lower terrace about 15 ft above the river are probably flooded once every 10 to 15 years and this must therefore be considered a hazard to continuous agricultural use. The Prophet soils on the upper terrace are flooded only rarely, but even here, 25 to 30 ft above the river, this hazard cannot be entirely ruled out.

Consolidated bedrock. The physical limitation of consolidated bedrock occurs only rarely in the area. In the high parts of the Sikanni terrain system shales occasionally come to within 12 inches of the soil surface and shale fragments occur commonly throughout the shallow mineral soil. These shallow portions of the Sikanni soils are restricted to those parts of the plateau above 2,000 ft.

Topography. Adverse topography is coupled with potential erosion damage and most of the soils having this physical limitation have been mentioned under

"Erosion." Thus, the Mino and Donaldson soils of the steep river valley sides and some occurrences of the Sikanni soils on the steeper slopes of the Sikanni terrain system would be unworkable by agricultural machinery. In places the Trail, Jackfish, Fort Nelson, and Hamilton soils also occur on ridges or slopes, which would cause some difficulty in the widespread use of agricultural machinery.

Excess water. Apart from adverse climate, excess water is the main problem facing agricultural development in the Fort Nelson area. The flat or very gently sloping portions of the Buckinghorse, Sikanni, and Chuatse terrain systems, whether they are underlain by clay, clay loam, or sand, have very limited surface runoff and soil permeability. All soils in these portions are therefore wet. Organic soils (Parker and McConachie series and the Klua complex) cover nearly 60% of the area. Their agricultural potential is extremely limited because the deep undecomposed sphagnum peat is very acid and drainage would be difficult in such extensive flat terrain underlain by slowly permeable clays, silty clays, and clay loams. An exception would possibly be the limited areas of shallow McConachie soils where the undulating topography of the Sikanni terrain system would locally allow excess water to be drained off. These soils have a neutral pH, high organic matter content, and adequate N (Table 5). Certain areas of the Klowee soils would possibly be reclaimable for arable crops for the same reasons. But generally the Klowee soils, like the other gleysolics, the Utahn and Simpson soils, are suitable even on the better sites only for the production of native grasses.

Excess water poses some limitations to agriculture in even the moderately well drained Sikanni and Fort Nelson soils as well as the imperfectly drained Hamilton soils. These soils are wet for a long time during spring snowmelt. Because they are also cold, germination is retarded. However, they do retain their structure and remain cultivable when wet.

Moisture limitation. All the well-drained sandy soils are low in moisture-holding capacity. This limitation is often so severe in the deep sand or gravel sola of the Pouce, Trail, and Bar soils that without irrigation agricultural production is limited to perennial forage crops. Some irrigation may be possible from the creeks near the Pouce soils, but there is very little water available for irrigation near most of the places where Trail or Bar soils occur.

This limitation is not quite so restrictive where the sandy deposits form a thin capping over clays or clay loams as in the Jackfish and Donaldson soils. With suitable topography these soils would be capable of producing marginal arable crops.

The Snake soils with sandy loam sola will also suffer from moisture deficiency under arable agriculture, but irrigation water is available nearby from the main rivers. Below Fort Nelson airport these soils are used successfully for growing garden vegetables.

Undesirable soil structure and low permeability. Undesirable soil structure and low permeability are found in those soils developed on clay or clay loam parent materials where soil genesis has caused clay to be translocated from the A into the B horizon. The B horizons are slowly permeable to air, water, and roots. This tendency is found in the Fort Nelson, Sikanni, and Hamilton soils. But the problem is not severe in the Fort Nelson area, because in all these soils roots penetrated the B horizon and extended into the underlying C.

Low fertility. Taken in the context of the whole area low fertility is not as serious a limitation to agriculture as potential erosion damage, excess water, and adverse topography. However, most potentially arable soils are low in natural fertility.

The Fort Nelson soils have medium acid sola to a depth of 30 inches and are low in organic matter, N, S, and cation-exchange capacity (Table 4). Some crop experiments were carried out on these soils at Mile 319 on the Alaska Highway from 1964 to 1966 (3). Cereals responded to N and P but not to S or lime. The addition of K would also probably be beneficial. These results are slightly anomalous in relation to data in Table 4 where S is low, but P is not. Grasses responded to N and legumes to P; mixtures would probably require N, P, and K. The associated imperfectly drained Hamilton soils are also acid, and low in N and cation-exchange capacity, but have higher organic matter and easily soluble P and S contents than the Fort Nelson soils, probably because of less leaching (Table 4). However, under sustained agriculture they would probably require the same amendments as the Fort Nelson soils.

The Sikanni soils have strongly to very strongly acid sola, and are low in organic matter content, N, cation-exchange capacity, and easily soluble P and S (Table 4). They would therefore probably need all the amendments that were found necessary for the Fort Nelson soils, in addition to lime.

All the sandy soils in the area are very low in natural fertility. Most are rated only marginal for arable agriculture and their main limitation will be low moisture-holding capacity. Their main use would be for the production of forage crops. Sample analyses of the Trail soils showed them to have medium to strongly acid sola with very low organic matter contents (0.2–0.4%), N (0.01–0.02%), and cation-exchange capacity (3.0–5.2 meq/100 g). The gravelly Pouce soils (Table 4) have slightly higher organic matter contents, N, and cation-exchange capacity, but would still probably require the addition of N, P, and K fertilizers for the successful production of forage crops. This would also apply to the Jackfish, Bar, and Donaldson soils.

The two soils of the alluvial bottomlands, the Prophet and Snake soils (Table 5), have mildly alkaline sola caused by an abundance of Ca, which saturates the exchange complex. The Ca ties up the P as $Ca_3(PO_4)_2$, and the addition of P as well as N will probably be necessary for successful crop growth. Organic matter contents are moderate to high. The Prophet soils have the greatest potential for crop growth in the area, although they may sometimes occur in frost pockets. The Snake soils are low in moisture-holding capacity, but have considerable potential under irrigation, as the vegetable plots below Fort Nelson airport show.

Miscellaneous considerations. Forest growth is very heavy on the well-drained and moderately well drained soils, and clearing costs are high. Balsam poplar (Snake soils), white spruce (Prophet soils), and trembling aspen (Fort Nelson, Sikanni, Jackfish, and Trail soils) all grow to a large size and heavy bulldozing machinery is necessary for land clearing (Fig. 17). Costs would be cut on land where small second-growth trees have come in after a fire. However, care should be taken to ensure that the reason for the small tree growth is fire history and not a poorly drained soil.

Access to land suitable for agricultural development is difficult. Many acres of suitable soil occur in isolated pockets. The Prophet and Snake soils occur on numerous river terraces, each of which must be approached by a separate road constructed down the side of the river valley from the plateau above. Similarly, much organic terrain must be traversed on the plateau before many acres of Fort Nelson or Sikanni soils can be developed.

Fig. 17. Land clearing on the Sikanni soils.

Soils and Forestry

M. J. Romaine and K. W. G. Valentine*

Much of the information included in this section is derived from the Canada Land Inventory land capability for forestry survey conducted by the senior author at the same time as the soil survey.

Each soil and land type was rated in one of seven classes according to its inherent ability to produce commercial timber. The methods of plot selection and stand measurement and the assumptions made in rating the land for forestry are those given by McCormack (7). The results of this survey are included in Table 7. The table shows the capability class (and its associated mean annual increment range), the physical limitations of the soil to tree growth, suitable commercial species, and various land management considerations.

White spruce is the species of highest present and potential commercial value

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Table 7. Forest Capability Interpretations for Soils and Land Types of the Fort Nelson Area

Terrain system	Series or land type	Capability class*	Limitations	Species suitability: Suitable	Species suitability: Limited suitability	Land management considerations: Cutting systems	Land management considerations: Regeneration requirements	Land management considerations: Optimum stocking levels stems/acre
Bucking-horse	Fort Nelson	2-3	D	white spruce, trembling aspen	balsam poplar, white birch	Clear cut, leave strips	plant	Class 2 200-450 Class 3 300-650
	Hamilton	3	D,H	white spruce, trembling aspen, balsam poplar	lodgepole pine, white birch	Clear cut, leave strips	scarify and plant	300-650
	Simpson	5	W		white spruce, balsam poplar, black spruce, white birch	Clear cut, leave strips	scarify and plant	300-650
	Parker	7	W,H		black spruce	Forest stands left for soil and water conservation		
	Klua complex	7	W,H		black spruce	Forest stands left for soil and water conservation		
Sikanni	Sikanni	3	D	white spruce, trembling aspen	lodgepole pine, white birch	Clear cut, leave strips (along contours on sloping land)	plant	300-650
	Klowee	6	W,H		black spruce	Forest stands left for soil and water conservation		200-450
	McConachie	7	W,H		black spruce	Forest stands left for soil and water conservation		
	Pouce	5	M	lodgepole pine	trembling [illegible]	[illegible]		

	Jackfish	3	M,D	white spruce, trembling aspen	balsam poplar, lodgepole pine, white birch	Clear cut, leave strips	plant	300-650
	Meltwater channels	5-7			trembling aspen, lodgepole pine, black spruce	Forest stands left for soil and water conservation		Class 5 300-650 Class 7 100-250
Chuatse	Trail	5	M	lodgepole pine	trembling aspen	Clear cut, leave strips	seed	300-650
	Utahn	7	W,H		black spruce	Forest stands left for soil and water conservation		
	Bar	5	M	lodgepole pine	trembling aspen	Clear cut, leave strips	seed	300-650
Muskwa	Donaldson	3	D,M	white spruce, trembling aspen	balsam poplar, white birch	Clear cut, leave strips along contour of slopes	plant	300-650
	Milo	2	S	white spruce, trembling aspen	balsam poplar, white birch	Leave steep scarps and seepage slopes for soil and water conservation. On lower stable slopes clear cut, leaving strips along the contours	scarify and plant	200-450
	Prophet	1-2	S	white spruce, balsam poplar	trembling aspen, white birch	Clear cut, leave buffer zone along stream edge	scarify and plant	Class 1 100-250 Class 2 200-450
	Snake	3	M	white spruce, trembling aspen	balsam poplar white birch	Clear cut, leave buffer zone along stream edge	plant	300-650
	Abandoned river channels	6-7	W,I		balsam poplar	Forest stands left for soil and water conservation		100-250

Table 7. Forest Capability Interpretations for Soils and Land Types of the Fort Nelson Area (cont'd)

				Species suitability		Land management considerations		
Terrain system	Series or land type	Capability class*	Limitations	Suitable	Limited suitability	Cutting systems	Regeneration requirements	Optimum stocking levels stems/acre
	Recent bars	7	I					
	Valley side slumps	4-3	D	white spruce, trembling aspen	balsam poplar, white birch	Leave steep backwalls and seepage slopes for soil and water conservation. Lower slopes on stable debris of old slides may be clear cut, leaving strips along contours	plant	300-650

* Capability classes based on mean annual increment measurements

Class	Cubic feet/acre per year
1	over 110
2	91-110
3	71- 90
4	51- 70
5	31- 50
6	11- 30
7	0- 10

Limitations

- M Soil moisture deficiency
- W Excess of soil moisture
- I Soils periodically inundated by streams
- D Limited rooting depth due to dense or consolidated layers other than bedrock
- H Short, cool growing season (cold air drainage and low soil temperatures)
- S A combination of soil factors, none of which, by themselves, would affect the class level, but cumulatively they lower the capability class.

Optimum stocking levels are based on the number of stems per acre likely to yield the highest [illegible]
year at an assumed [illegible]

in the area and is well suited to the productive soils. However, in terms of present areal extent trembling aspen is by far the most abundant species on these soils. There is evidence of past fires throughout much of the area, and the present scarcity of white spruce is probably due to faster regeneration of trembling aspen after these fires. The only consistent occurrence of white spruce is on the alluvial Prophet soils of the Muskwa terrain system. Here it is noticeable that fires have occurred on the Donaldson and Milo soils of the valley slopes, but do not seem to have reached the Prophet or Snake soils of the bottomlands.

At present the three deciduous species trembling aspen, balsam poplar, and white birch have limited market value. This is not only because of the high transportation costs from Fort Nelson but also because the wood quality has limitations for pulping purposes and no structural strength for timber products. Moreover, there is a relatively limited volume of suitable grade compared with the abundance of softwoods in other areas. Therefore, the extension of the Pacific Great Eastern Railway to Fort Nelson will probably lead, in the foreseeable future, to increased exploitation of the softwoods of the area rather than to the initiation of the use of the deciduous species.

Future forest management practices should be concentrated on the Class 1 to 3 soils. These moderately well and imperfectly drained soils are productive enough to warrant continued intensive management such as planting and scarification after logging to ensure the regeneration of white spruce. Besides this, extensive management practices such as fire protection should continue to be applied to the area as a whole.

The level or gently undulating land of much of the Buckinghorse and Sikanni terrain systems lends itself to mechanical harvesting methods. The problems of trafficability of the silty clay and clay loam soils with high water content could be resolved by cutting the trees in the winter when the ground is frozen.

The Muskwa terrain system presents special access problems because the sections of mature timber on the Prophet and Snake soils alternate from one side of the valley to the other. The construction of separate access roads from the Plateau to each terrace is complicated by the potential instability of the flat-lying marine shales. Logging has therefore tended to be limited to the winter when ice bridges can be built across the rivers. Furthermore, the Muskwa terrain system as a whole requires the careful application of soil and water conservation principles if the land is to be managed properly. Those parts of the Donaldson soils and the valley side slumps that occur on steep slopes and the Milo soils on seepage slopes should be left as protection forests. Where these soils occur on lower, more stable slopes trees could be harvested by alternating rows of leave-strips and clear-cut along the contours. Any logging plans proposed for the Prophet and Snake soils of the bottomlands should include a buffer zone along the edge of streams. The timber that is present on the abandoned river channels and recent bars should be left as protection forest.

Soils and Wildlife

The influence of soils on wildlife is primarily exerted indirectly through vegetation distribution and soil moisture conditions. Thus in the Fort Nelson area the concentration of waterfowl is on wetlands, where the marsh habitat provides suitable sites and materials for nesting, as well as plant species and insects for food. The suitability of winter range for moose depends principally on the abundance of browse species; beaver concentrate mainly where trembling aspen or balsam poplar occur close to streams or rivers.

The most important locality within the Fort Nelson area for the production of waterfowl, such as ducks, geese, and sandhill cranes, is the plateau of the Buckinghorse terrain system, although it is of only moderate importance within British Columbia. The level topography and slowly permeable silty clay soils allow limited surface runoff. Numerous lakes and ponds occupy the depressions in this landscape. However, many of these water bodies are very shallow and probably extremely acid as a result of the surrounding Parker and Klua organic soils, They are almost stagnant and do not receive concentrations of mineral and organic nutrients from inflowing streams. Plant and insect food for waterfowl is likely to be limited. Moreover, the marsh edges, which are often floating masses of sphagnum mosses and sedges, do not provide suitable nesting sites. Ducks and geese are produced in significant numbers on only the larger lakes such as Clarke, Parker, and Klowee, and some of the smaller ponds where inflowing streams are believed to contribute to a higher water pH and increased fertility for waterfowl food. The marsh edges also tend to be more suitable for nesting. Measurements of water samples from Clarke and Parker lakes showed the pH to be 6.8 and 7.4 (pH values for the Parker and Klua soils range from 3.1 to 5.9) and the total dissolved solids to be 80 and 120 ppm, respectively (personal communication). Freshwater shrimp, insects, pondlilies, and cattail are abundant. The importance of the section as a whole, however, lies in the very large number of waterbodies that produce some ducks, rather than a few being excellent producers.

These lakes and ponds also serve as resting stops in the spring and autumn for birds on the migration route between Alaska and the southern wintering grounds of North America. The undulating land of the Sikanni terrain system does not contain many wetlands suitable for waterfowl production. Most of the rather flat land is blanketed by the Klowee and McConachie soils and drained by slow-flowing streams. The ponds that do occur are used as migration stops rather than for nesting and breeding.

Similarly the Muskwa terrain system has little importance as production land because of the general lack of suitable wetlands, the proximity of large fast-flowing rivers, and the danger of flooding. The abandoned river channels afford the only sections of potential nesting and breeding habitat. However, the recent bars are very important stops for ducks, geese, and cranes on the spring and autumn migrations. They provide protection and supplies of grit for the birds.

Unlike waterfowl, most other animals in the Fort Nelson area do not migrate far, if at all, during the year. Therefore, the suitability of land for these animals must be judged on its ability to support them during the winter, or on its proximity to suitable winter range.

The most suitable winter range for moose and the occasional caribou and elk is found in the Muskwa terrain system. The lower elevation, the rather shallow snow depth, and the occurrence of browse vegetation are the principal contributing factors. All the soils support a large population of moose in the winter. Red-osier dogwood and willows, both important browse species, grow abundantly on the Prophet and Snake soils. The same species, as well as young white birch and trembling aspen, are occasionally found on the Donaldson and Milo soils; balsam poplar regeneration and willows supply browse on the recent bars and abandoned river channels. The whole section is important for summer range too, but its main significance is as high-quality winter range.

There are numerous bank-dwelling beaver along the Muskwa River where lodges are built against the cutbanks of the Prophet and Snake soils. Further, these main rivers and their numerous tributaries are clear of ice in the spring before the adjacent plateau sites, and many beaver move from the frozen ponds of the Buckinghorse terrain system to the rivers and tributaries of this section. Trembling aspen, balsam poplar, willows, and white spruce are the main vegetation types used. Otter, mink, and muskrat also occur in these wetlands.

The soils of the Buckinghorse terrain system are only moderately useful as winter range for moose and caribou due to increased snow depth and elevation and fewer browse species. However, they do supply good-quality summer range and are close to the winter range of the Muskwa terrain system. Red-osier dogwood is abundant on the Fort Nelson soils, and willows are common on the Hamilton, Simpson, and Parker soils. But the main attraction for moose is the wetland environment, which apart from providing aquatic vegetation such as pondlilies for food also serves as an escape from the swarms of flies in summer. The organic Parker and Klua soils also have growths of caribou moss, an important food for caribou.

The wetlands of the Buckinghorse terrain system provide excellent habitat for beaver. The animals concentrate mainly in the slow-flowing streams such as the headwaters of the Snake River and in the numerous meltwater channels to the east. Along their banks are narrow strips of Fort Nelson, Hamilton, and Simpson soils with varying concentrations of trembling aspen. As a result of this combination of water environment and vegetation, beaver dams and lodges occur every few hundred yards along some of these streams and meltwater channels (Fig. 18). The more stagnant potholes among the Parker and Klua soils offer less suitable beaver habitat because of the absence of trembling aspen.

Marten, fishers, lynx, wolverines, and wolves also occur in these wetlands.

The soils of the Sikanni terrain system provide little winter range for moose, as they occupy the highest elevations in the area and snow depth is a significant limiting factor. Their main importance is for summer range because of the willows and caribou moss that grow on the Klowee and McConachie soils, the aquatic vegetation of the occasional wetlands, and their proximity to the Muskwa terrain system winter range. Beaver use the slow-flowing streams where adjacent stands of trembling aspen occur, but generally these soils are not as suitable for the production of wildlife as those of the Muskwa or Buckinghorse terrain systems.

Soils and Recreation

Soil characteristics are one of a number of factors that limit the ability of the land in the Fort Nelson area to support intensive recreational activities. Recreation capability is further limited by the lack of individual features and attractions.

The plateau landscape is monotonously regular. There is little change of slope or vegetation. Access to much of this land is difficult during the summer because the clay and clay loam soils of the Buckinghorse and Sikanni terrain systems are usually wet. Most of these soils are organic and are impassable to ordinary vehicles. Even the moderately well drained Fort Nelson and Sikanni soils have limited recreational use because they would be unable to support the intensive traffic of picnic sites or campgrounds. When the soil is wet, the surface is unstable and the vegetation would be easily destroyed by the traffic.

The river valleys of the Muskwa terrain system have greater potential for recreation owing partly to the more varied vegetation and the wildlife that are

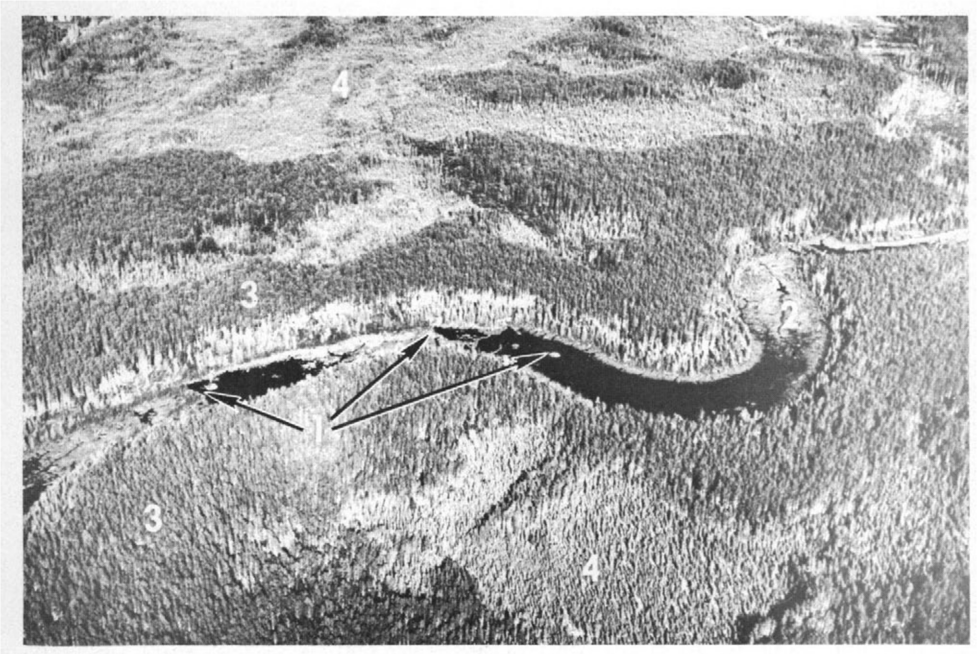

Fig. 18. View east of the Snake River showing numerous beaver dams and lodges (1) where the meltwater channels (2) are bordered by the Fort Nelson and Hamilton soils with a cover of dominantly trembling aspen (3). Klua and Parker soils occur on the level topography (4) away from the meltwater channels.

dependent on the soils. However, the Prophet and Snake soils of the alluvial terraces have some limitations for camping and cottaging because of flooding and wetness. Access to these valleys is also limited because the Milo and Donaldson soils tend to slump on the slopes. Cottages or campsites should be located on the high benches such as the one on which Old Fort Nelson is built. The sandy Trail and Jackfish soils along Jackfish Creek have possibilities for recreation development along one of the few streams in the area that offer clear-water fishing for grayling and jackfish.

As tourist traffic increases on the Alaska Highway, Fort Nelson will likely need an overnight campground for visitors. This should be located on the single exposure of Bar soils with a view overlooking the Muskwa or Fort Nelson River, or on the Pouce soils west of Fort Nelson.

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GLOSSARY

alluvium. A general term for all deposits of modern rivers and streams.

base-saturation percentage. The extent to which the adsorption complex of a soil is saturated with exchangeable cations other than H and Al. It is expressed as a percentage of the total cation-exchange capacity.

bulk density. The weight of ovendry soil (105 C) in grams per unit bulk volume. The bulk volume is measured in cubic centimeters at field moisture conditions.

catena. A sequence of soils of about the same age, derived from similar parent materials and occurring under similar climatic conditions, but having different characteristics because of variations in relief and in drainage.

cation-exchange capacity. The total exchangeable cations that a soil can adsorb expressed in milliequivalents per 100 g of soil or of other adsorbing material such as clay. This is sometimes called "total-exchange capacity," "base-exchange capacity," or "cation-adsorption capacity."

chroma. The relative purity, strength, or saturation of a color; directly related to the dominance of the determining wavelength of the light and inversely related to grayness; one of the three variables of color. See *Munsell color system; hue;* and *value, color.*

clay films. Oriented clay particles forming a coating on the surface of the soil aggregates and indicating translocated clay in the soil profile. Clay bridges are similar to clay films, but instead of forming coatings they form a latticework or bridges among the sand grains. They are found in medium- and coarse-textured soils.

colluvium. A heterogeneous mixture of material that has moved down a slope and settled at its base. See *creep.*

color. See *Munsell color system.*

complex, soil. See *soil complex.*

creep. Slow mass movement of soil and soil material down relatively steep slopes primarily under the influence of gravity, but facilitated by saturation with water and by alternate freezing and thawing.

glacial drift. Rock material that has been transported by glacier ice and glacial meltwater or rafted by icebergs. This term includes till, stratified drift, and scattered rock fragments.

gravel. Rock fragments 2 mm to 3 inches in diameter.

horizon. See *soil horizon.*

hue. One of the three variables of color. It is caused by light of certain wavelengths and it changes with the wavelength. See *Munsell color system; chroma;* and *value, color.*

leaching. The removal from the soil of materials in solution.

mottles. Spots or blotches of different color or shades of color interspersed with the dominant color.

Munsell color system. A color designation system that specifies the relative degrees of the three simple variables of color: hue, value, and chroma. For example: 10YR 6/4 is a color (of soil) with a hue of 10YR, a value of 6, and a chroma of 4. These notations can be translated into several different systems of color names as desired. See *chroma; hue;* and *value, color.*

parent material. The unconsolidated and more or less chemically weathered mineral or organic matter from which the solum of a soil is developed by pedogenic processes.

permeability, soil. (i) The ease with which gases, liquids, or plant roots penetrate or pass through a bulk mass of soil or a layer of soil. Because different soil horizons vary in permeability, the particular horizon being studied should be designated. (ii) The property of a porous medium that relates to the ease with which gases, liquids, or other substances can pass through it.

pH, soil. The negative logarithm of the hydrogen-ion activity of a soil. The degree of acidity (or alkalinity) of a soil as determined by means of a glass, quinhydrone, or other suitable electrode or indicator at a specified moisture content or soil-water ratio, and expressed in terms of the pH scale.

reaction, soil. The degree of acidity or alkalinity of a soil, which is usually expressed as a pH value. Descriptive terms commonly associated with certain ranges in pH are: extremely acid, < 4.5; very strongly acid, 4.5–5.0; strongly acid, 5.1–5.5; moderately acid, 5.6–6.0; slightly acid, 6.1–6.5; neutral, 6.6–7.3; slightly alkaline, 7.4–7.8; moderately alkaline, 7.9–8.4; strongly alkaline, 8.5–9.1; and very strongly alkaline, > 9.1.

series, soil. The second-lowest category in the System of Soil Classiciation for Canada. This is the basic unit of soil classification and consists of soils that are essentially alike in all the main profile characteristics except the texture of the surface.

soil complex. A mapping unit used in detailed and reconnaissance soil surveys where two or more defined soil units are so intimately intermixed geographically that it is impractical, because of the scale used, to separate them.

soil horizon. A layer of soil or soil material approximately parallel to the land surface; it differs from adjacent genetically related layers in properties such as color, structure, texture, and consistence, and chemical, biological, and mineralogical composition.

The following is a list of the designations and some of the properties of soil horizons. More detailed definitions of some horizons may be found in *The System of Soil Classification for Canada.*

Organic layers contain more than 30% organic matter. Two groups of these layers are recognized:

O–Organic layers developed under poorly drained conditions and that are often peaty.

- Of–The least decomposed kind of O layer. It contains large amounts of well-preserved fiber.
- Om–An intermediately decomposed O layer containing less fiber than an Of layer.
- Oh–The most decomposed O layer. This humic layer contains little raw fiber.

L, F, and H–These are organic layers developed under imperfectly to well-drained conditions and they are often composed of forest litter.

- L–The original structures of the organic material are easily recognizable.
- F–The accumulated organic material is partly decomposed.
- H–The original structures of the organic material are unrecognizable.

Master mineral horizons and layers contain less than 30% organic matter.

A–A mineral horizon formed at or near the surface in the zone of removal of materials in solution and suspension or maximum in situ accumulation of organic matter or both.

B–A mineral horizon characterized by one or more of the following:

1. An enrichment in silicate clay, iron, aluminum, or humus.
2. A prismatic or columnar structure that exhibits pronounced coatings or stainings associated with significant amounts of exchangeable sodium.
3. An alteration of hydrolysis, reduction, or oxidation to give a change in color or structure from horizons above or below or both.

C–A mineral horizon comparatively unaffected by the pedogenic processes operative in A and B, except gleying, and the accumulation of carbonates and more soluble salts.

R–Underlying consolidated bedrock.

Roman numerals are prefixed to horizon designations to indicate unconsolidated lithologic discontinuities in the profile. Roman numeral I is understood for the uppermost material and therefore is not written. Subsequent contrasting materials are numbered consecutively in the order in which they are encountered downward, that is, II, III, etc.

Lower-case suffixes

b—Buried soil horizon.

c—A cemented (irreversible) pedogenic horizon.

ca—A horizon of secondary carbonate enrichment where the concentration of lime exceeds that in the unenriched parent material.

cc—Cemented (irreversible) pedogenic concretions.

e—A horizon characterized by removal of clay, iron, aluminum, or organic matter alone or in combination and higher in color value by one or more units when dry than an underlying B horizon. It is used with A, (Ae).

f—A horizon enriched with hydrated iron. It usually has a chroma of 3 or more. The criteria for an f horizon (except Bgf) are: the oxalate-extractable Fe + Al exceeds that of the IC horizon by 0.8% or more, and the organic matter to oxalate-extractable Fe ratio is less than 20. These horizons are differentiated on the basis of organic matter content into:

Bf, less than 5% organic matter.

Bfh, 5% to 10% organic matter.

Bhf, greater than 10% organic matter.

g—A horizon characterized by gray colors or prominent mottling indicative of permanent or periodic intense reduction, e.g., Aeg, Btg, Bg, and Cg.

gf (used with B)—The dithionite-extractable Fe of this horizon exceeds that of the IC by 1% or more and the dithionite-extractable Al does not exceed that of the IC by more than 0.5%.

h—A horizon enriched with organic matter.

Ah—An A horizon of organic matter accumulation. It contains less than 30% organic matter. It is one Munsell unit of color value darker than the layer immediately below or it has at least 1% more organic matter than the IC or both.

Ahe—This horizon has been degraded as evidenced by streaks and splotches of light and dark gray material and often by platy structure.

Bh—This horizon contains more than 2% organic matter and the organic matter to oxalate-extractable Fe ratio is 20 or more.

j—This is used as a modifier of suffixes e, g, n, and t to denote an expression of but failure to meet the specified limits of the suffix it modifies, e.g., Aej—an eluvial horizon that is thin, discontinuous, or faintly discernible.

k—Presence of carbonate.

m—A horizon slightly altered by hydrolysis, oxidation, or solution, or all three to give a change in color or structure or both.

n—A horizon in which the ratio of exchangeable Ca to exchangeable Na is 10 or less.

p—A layer disturbed by man's activities. Ap.

s—A horizon containing detectable soluble salts.

sa—A horizon of secondary enrichment of salts more soluble than Ca and Mg carbonates where the concentration of salts exceeds that present in the unenriched parent material.

t—A horizon enriched with silicate clay as indicated by: a higher clay content (by specified amounts) than the overlying eluvial horizon, a thickness of at least 5 cm, oriented clay in some pores or on ped surfaces or both, and usually a higher ratio of fine (<0.2 micron) to total clay than the IC horizon.

x—A horizon of fragipan character.

z—A permanently frozen layer.

soil reaction. See *reaction, soil* and *pH, soil*.

soil structure. The aggregation of primary soil particles into compound particles, which are separated from adjoining aggregates by surfaces of weakness. Aggregates differ in grade (distinctness) of development and grade is described as structureless (no observable aggregation or no definite orderly arrangement but amorphous if coherent or single grained if noncoherent) weak, moderate, and strong. The aggregates vary in class (size) and are described as fine, medium, coarse, or very coarse. The size classes vary according to the type (shape) of structure. The types of structure mentioned in the report are:

granular—having more or less rounded aggregates without smooth faces and edges, relatively nonporous.

platy—having thin, platelike aggregates with faces mostly horizontal.

prismatic—having vertical prisms with well-defined faces and angular edges.

blocky—having blocklike aggregates with sharp, angular corners.

subangular blocky—having blocklike aggregates with rounded and flattened faces and rounded corners.

An aggregate is described in the order of grade, class, and type. Two examples of this convention are: strong, medium blocky; moderate, coarse granular.

soil texture. The percentages of sand, silt, and clay in a soil determine its texture. Size groups from 2 mm to 0.05 mm in diameter are called sand, those from 0.05 to 0.002 mm are called silt, and those less than 0.002 mm in diameter are called clay. Sands are coarse textured, loams are medium textured, and clays are fine textured.

solum (sola). The upper horizons of a soil in which the parent material has been modified and within which most plant roots are confined. It consists usually of A and B horizons.

value, color. The relative lightness or intensity of color and approximately a function of the square root of the total amount of light. One of the three variables of color. See *Munsell color system, hue,* and *chroma.*

COMMON AND SCIENTIFIC NAMES OF PLANTS

alder, mountain	*Alnus tenuifolia* Nutt.
aspen, trembling	*Populus tremuloides* Michx.
bearberry	*Arctostaphylos uva-ursi* (L.) Spreng.
berry, baked-apple	*Rubus chamaemorus* L.
birch, scrub	*Betula glandulosa* Michx.
birch, white	*B. papyrifera* Marsh.
buffaloberry, russet	*Shepherdia canadensis* (L.) Nutt.
bunchberry	*Cornus canadensis* L.
bush-cranberry, low	*Viburnum edule* (Michx.) Raf.
cattail	*Typha* sp.
cranberry, mountain	*Vaccinium vitis-idaea* L. var. *minus* Lodd.
currant, bristly	*Ribes lacustre* (Pers.) Poir.
dogwood, red-osier	*Cornus stolonifera* Michx.
fir, alpine	*Abies lasiocarpa* (Hook.) Nutt.
fireweed	*Epilobium angustifolium* L.
horsetail, field	*Equisetum arvense* L.
horsetail, woodland	*E. sylvaticum* L.
moss, caribou	*Cladonia rangiferina* (L.) Web.
moss, hypnum	*Hylocomium splendens* (Hedw.) BSG.
moss, dotted mnium	*Mnium punctatum* Hedw.
peavine, creamy	*Lathyrus ochroleuchus* Hook.
pine, lodgepole	*Pinus contorta* Dougl. var. *latifolia* Engelm.
pondlilies	*Nuphar* spp.
poplar, balsam	*Populus balsamifera* L.
rose, wild	*Rosa* sp.
spruce, black	*Picea mariana* (Mill.) BSP.
spruce, white	*P. glauca* (Moench) Voss
strawberries	*Fragaria* spp.
tamarack	*Larix laricina* (DuRoi) K. Koch
tea, Labrador	*Ledum groenlandicum* Oeder
twinflower	*Linnaea borealis* L. subsp. *longiflora* Hulten
willow	*Salix* sp.

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